# MACHINERY.

**May, 1904.**

## ESTIMATING TIME FOR LATHE WORK.

HENRY HESS.

When called on to fix the price for a job the man who has this by no means agreeable duty, at once tries to recall some more or less similar piece within his experience to serve as a guide and precedent. Only when no such piece can be called to mind is recourse had to an analysis of the various operations to be performed and to estimating the time each is likely to occupy, from which the price to be offered the workman may be fixed. Then begins a course of bargaining, one side holding that the time was altogether underestimated, only to be met with the assurance that the most extravagant, unjustifiable and almost ruinous liberality characterized the estimate all through. Then, if the ratefixer is not a man of great tact and in possession of the good will and confidence of the men, these, in doing the work, will prove most conclusively that he was all "off"—as what proof could be more conclusive than that the job did take much more than the estimated time? "For ways that are dark and tricks that are vain," not only "the heathen Chinee is peculiar."

The alternative of simply forcing through a rate without chance of discussion by the workman is a plan that never works for very long unless the rate determination is based on thoroughly uniform and just methods; it will not answer to have different prices given out for the same or similar work at different times, for, aside from the inherent injustice involved, it is wonderful how well the men keep posted. Mere estimates, as usually arrived at by reliance on the experience of the rate fixer, never can, even with the most just and capable of estimaters, attain the necessary consistency. Let a machine have come out too high in total costs and the rate fixer will inevitably reflect this experience in setting low rates for some time until the impression has worn off; similarly, if a machine has come well within the estimates, the involuntary tendency is toward greater liberality.

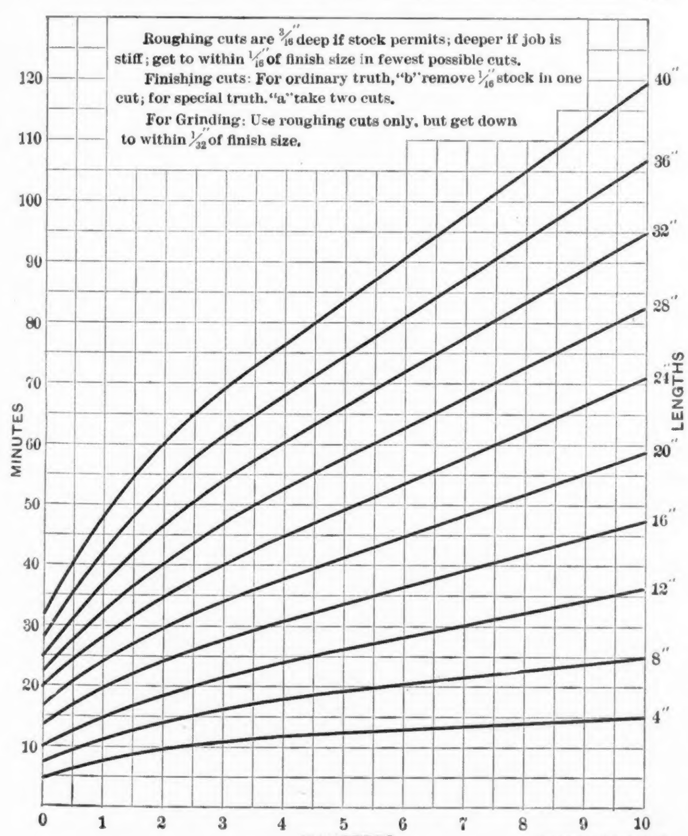


**Fig. 1. Chart giving Estimates for Turning Plain and Shouldered Shafts, etc.**

But substitute for such guesswork definite rules based on observation and experience and rigidly adhere to them and it will not be long ere the men recognize the consistency of the prices set, and evince a willingness to abide by the rate fixer's dicta and second him in his efforts to the advantage of all concerned.

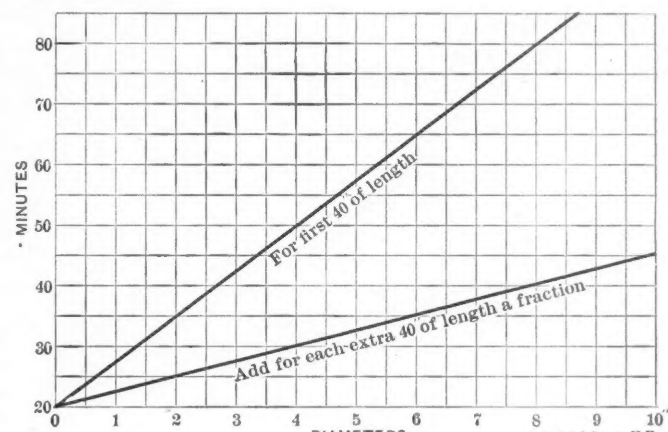


**Fig. 2. Handling Allowances.**

The rate-fixing methods worked out by Mr. Taylor and his school (I suppose it is as legitimate to speak of a school in matters of the shop and industrial arts as it is in the domain of the fine arts and letters) aim at this by a most minute study of all the elements affecting a given piece of work. Nothing better than these methods has as yet been proposed, but there are so far very few men trained to carry out and apply them; employers willing to incur the necessary first cost and time are also few and far between. Meanwhile half a loaf is better than none, and methods that have been found of decided utility and adaptable to the practice of various shops will answer very well so long as the more thorough ones are out of reach. In the main these consist in plotting on charts the results of experience with the individual operations into which any piece of work may be readily divided and in then using these charts to fix the time for new work. The estimates being thus always made on the same fixed basis are necessarily consistent. Continued comparison of actual results with the predictions of the chart will very soon, even with originally defective charts, lead to their correction, a work to which co-operation of the better and more intelligent and progressive element among the workmen will soon be cordially given.

Fig. 1 is such a chart for the turning of plain and shouldered shafts and spindles. As will be noted the base line gives one series of dimensions, in this case shaft diameters; various lines and curves in the body of the chart refer to some other main dimension, lengths in this case; and the vertical scale gives the time in minutes. The lines have been plotted as the result of observations which showed that up to about four inches diameter the time increase was less than directly proportional to the diameter, while after that for any given length the time increase could be represented by a straight line. Observation further showed that relatively more time is taken for long than for the shorter lengths. This is the reason that on the chart the time intervals between the curves for the various lengths are least in the region of the shorter shafts; the underlying cause is that long work is more springy than short, and therefore cannot be as quickly reduced.

The curves give the time for turning only, and, as there are time losses involved in handling, tool setting, etc., these also must be considered. Such losses are practically propor-

tional to the diameter and are given in Fig. 2 as "Handling Allowances." For all lengths up to 40 inches no change is made for length, but for each extra 40 inches an amount is added that is given by the lower of the two curves on the chart.

There remains the time for the work of turning up the ends and the shoulders. This allowance is taken from Fig. 3, marked "Time for Ending and Shouldering." Within the limits of the chart, 10 inches diameter, the time increases

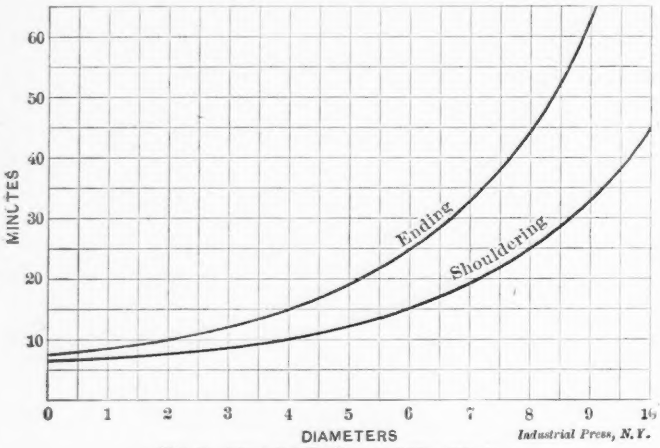


**Fig. 3. Time for Ending and Shouldering.**

faster than the diameter. The time for each end is given by the upper curve, while that for each shoulder is given by the lower curve.

As an example take the shaft shown in Fig. 4: Assume that this is to be turned out of solid stock 3⅞ inches diameter. Roughing cuts of 3-16 inch depth per side may be taken as a least depth. The first roughing cut would reduce the length marked I from 3⅞ to 3 9-16 inches, leaving the 3½ inches section ready for the finishing cut. Referring to Fig. 1, 30 minutes is given as the turning time for a length of 16 inches at 3⅞ inches diameter. A second, rather heavier roughing cut over II will reduce the sizes from 3 9-16 inches to 3 1-16 inches in 14 minutes by the chart. The last roughing cut will reduce 3⅞ inches to 3 3-16 inches; this is a cut of ⅜ inch depth per side, but as the length is only 18 inches, and moreover at the shaft end, this depth of cut is permissible. The time as taken from the chart is 34 minutes. If the work is to be quite true two finishing cuts should be employed for bringing it to size. For many purposes one cut will suffice; "a" marked on the size calls for two finish cuts, while "b" stands for one. By the chart the finish cut II for 6 inches length at 3 inches diameter takes 13 minutes, and two cuts, therefore, 26 minutes; the 10 inches length at 3½ inches diameter takes for two cuts $2 \times 20 = 40$ minutes; the one cut indicated by "b" at 3¾ inches diameter requires 74 minutes for its length of 40 inches; the 3⅛ inches and 18 inches long section uses up $2 \times 32 = 64$ minutes. The handling allowance by the chart, Fig. 2, is 59 minutes for the first 40 inches of length

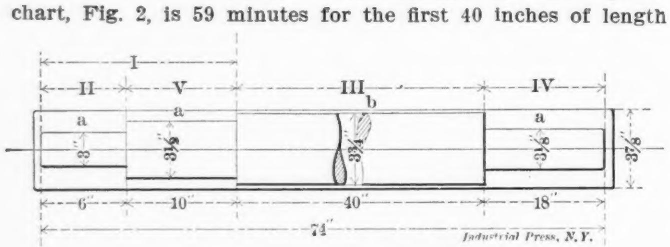


**Fig. 4. Shaft to be Turned out of Solid Stock.**

and 30 minutes for the next 40 inches or less; that gives a total of 79 minutes. Chart Fig. 3 for ending gives for each 3 inch end 12 minutes, or 24 for the two ends. The two shoulders at 3¾ inches diameter each take up 10 minutes, and the remaining shoulder at 3½ inches diameter 9 minutes, a total for shouldering of 29 minutes. Grouping the figures found for a more convenient oversight and addition we have:

| | Minutes. |
|---|---|
| I—One roughing cut 3⅞ inches to 3 9-16 inches x 16 inches length | 30 |
| II—One roughing cut 3 9-16 inches to 3 1-16 inches x 6 inches length | 14 |
| IV—One roughing cut 3⅞ inches to 3 3-16 inches x 18 inches length | 34 |
| II—Two finishing cuts 3 1-16 inches to 3 inches x 6 inches length | 26 |
| V—Two finishing cuts 3 9-16 inches to 3½ inches x 10 inches length | 40 |
| III—One finishing cut 3 13-16 to 3¾ inches x 40 inches length | 74 |
| IV—Two finishing cuts 3 3-16 inches to 3⅛ inches x 18 inches length | 64 |
| Handling allowance | 79 |
| Ending allowance, two 3-inch ends | 24 |
| Shouldering allowance, two at 3¾, one 3½ | 29 |
| Total | 414 |
| | Say 7 hours. |

The times derived from the charts are readily made by average men with lathes of ordinary stiffness and power and the common tool steels, which insures a liberal margin for high earnings by the piece or premium plan.

These charts are not presented as being correct for every job and every shop; no chart could be even approximately that. The time in which a certain piece of work can be done depends upon the lathe and the condition of its driving belt,

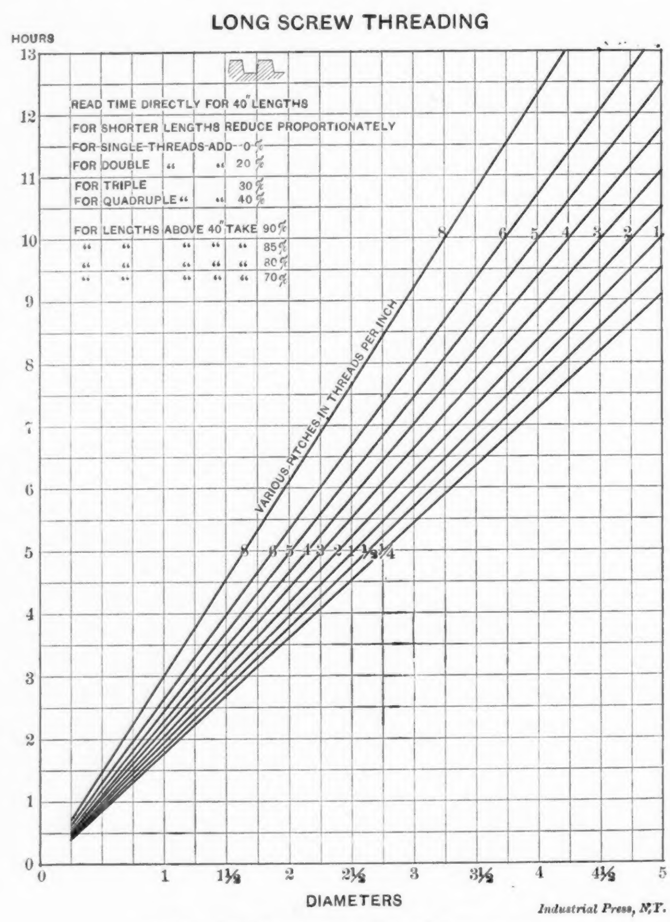


**Fig. 5. Time Estimate for Screw Threading.**

upon the man at the lathe and his environment; in fact, upon very many conditions, some of which, from their very nature cannot possibly be correctly allowed for. The only way of getting really and closely down to the lowest attainable time is by a most minute study of every controllable condition for each machine, and then seeing to it that the machine is in every way always maintained in prime order. As already stated, that involves an amount of work and also a method of shop foremanship that few are ready to accept, though such methods are undoubtedly capable of returning far more than their cost in increased output. None the less, these charts, or modifications based on experience in a particular shop, can be made to do very good service. With their aid a single man can set the rates for a surprisingly large number of jobs in a short time. My experience has proven that one man, aided by good detail plans, is able to set the entire times for all of the machining work on a machine tool weighing net about 30,000 pounds. As stated at the outset, one

advantage is that the times are set consistently, obviating the giving out to the shop of times that vary widely for practically identical jobs, as is inevitable even with the most careful and experienced men relying only on their judgment and memory of precedent. With the charts relatively inexperienced and cheaper men can do the work and make material errors only by gross carelessness. Should it be considered desirable, the work of one man can also be checked by a second one whereas under the older methods such checking is practically out of the question.

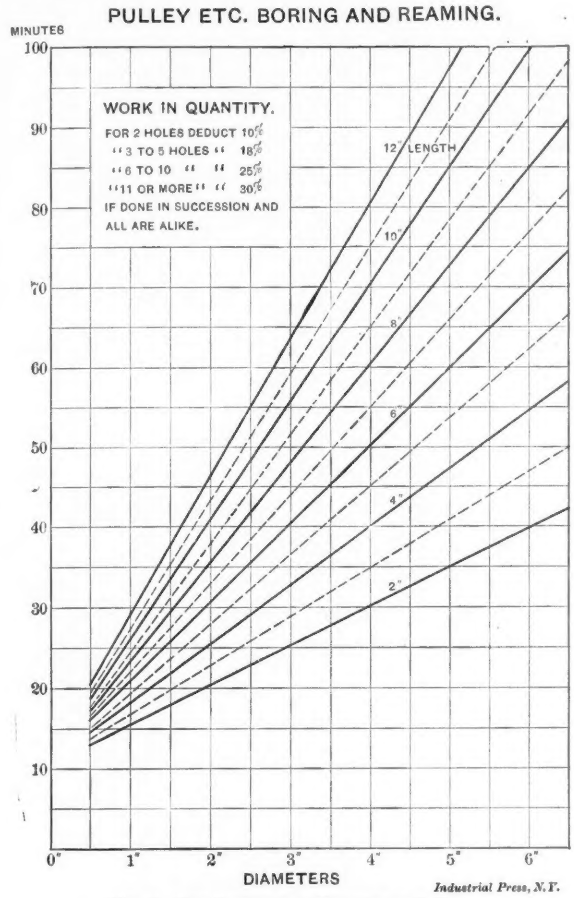


**Fig. 6. For Boring and Reaming a Pulley.**

The charts, Figs. 1, 2 and 3, are for ordinary lathe work; Figs. 5, 6 and 7 give time estimate for threading long screws, for pulley boring and turning, etc.

### Estimating Time for Long Threading.

Fig. 5 extends this subject to the threading of long screws, such as leadscrews, feedscrews, etc. It applies to the usual section having the sides inclined to include an angle of thirty degrees; but variations in this angle do not materially affect the time. Actually square threads will require more time if there is to be a genuine side fit; as this form has gone practically out of use, for close work at least, it may be disregarded. The character of the work on which the time is based is such as is usually found in the standard grade of machine tools. A good lathe hand should be able to earn a fair bonus over and above day rates by shortening the time taken from the chart, Fig. 5.

For single threads the time is to be read directly from the chart; for double threads 20 per cent. is to be added to compensate for the extra handling and the increased number of cuts; for triple threads 30 per cent. is added, and 40 per cent. for quadruple threads fairly represents the extra time taken up; 40 inches is assumed as the shortest length to be cut. Time needed does not increase proportionally, or at least not directly so; this will be fairly recognized by taking for the increased lengths 90, 85, 80 and 70 per cent. of the times derived from the chart for the first 40 inches for single, double, triple and quadruple threads respectively.

Logically, lengths of less than 40 inches should be assigned time at an increased ratio; but as screws of the character being considered are rarely much shorter than 40 inches it is advisable to avoid complications by reducing the chart times in direct proportion.

By the chart a leadscrew of 3½ inches diameter, single, two threads per inch and 140 inches long, should be threaded in 7.3 hours for the first 40 inches and in $0.9\left(\frac{140-40}{40}\right)7.3 = 16.4$ hours for the rest of its length, or a total of 23.7 hours for the entire length.

Were the thread to be double, the times would be 7.3 + 20 per cent. = 8.75 hours for the first 40 ins. and $0.85\left(\frac{140-40}{40}\right) 8.75 = 18.5$ hours for the balance, or 27.5 hours for the entire length.

The time given is that for the threading only; the turning time for preparing the screw for threading is found from charts Figs. 1 to 3 for plain turning.

### Time for Pulley Boring and Reaming, Turning and Polishing.

The time required to bore, ream, turn and polish pulleys will vary greatly with the facilities provided. Good results with trained shop laborers can be had if the boring and reaming is done on vertical turret boring machines, finishing the hole with a hand reamer while holding the pulley in a reaming stand fitted with a universal chuck. Turning and polishing is done in pulley lathes of the type having a rest back and front and a fast running polishing arbor that can be used while the turning is going on.

For boring and reaming, the time varies with the diameter and length of the hole, and, of course, also with the number of one size being dealt with successively. Fig. 6 gives the time in minutes for bore diameters up to 6 inches and 2 to 12 inches length of hub. To bore and ream a single hole 4 inches diameter by 6 inches long will, according to the chart, Fig. 6, take 50 minutes time. If from six to ten similar pieces were to be treated successively the time would be reduced by 25 per cent. to 37 minutes; the small table in the corner of the chart gives the reduction for lots of various quantities.

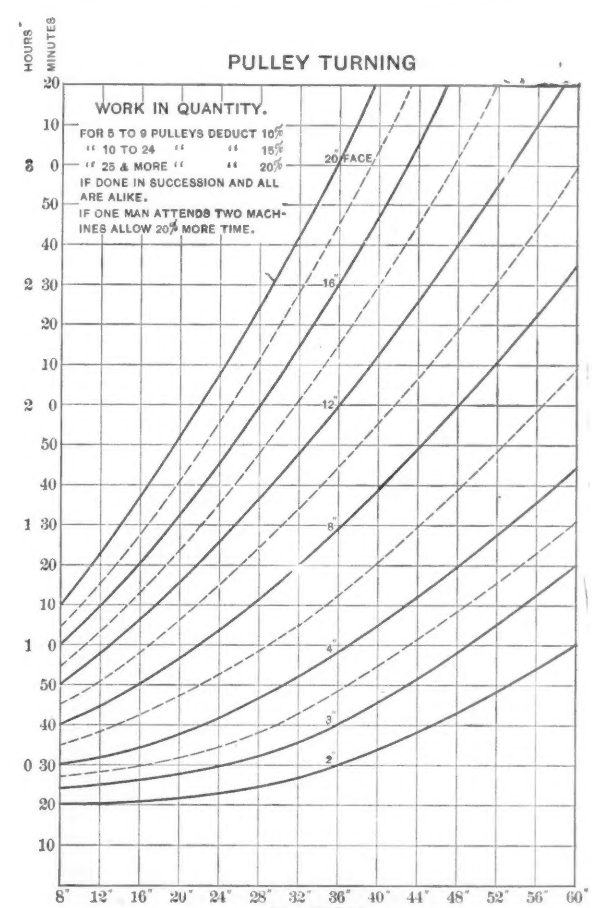


**Fig. 7. For Turning and Polishing Pulleys.**

The chart is based on the use of one rough boring cut, followed by a rose reamer, and that in turn by a machine reamer; as mentioned before, the final sizing is by hand reaming. The time is susceptible of considerable shortening by active men and by attention in the foundry to careful centering of the core and a minimum amount of finish. The chart is, of course, useful also in connection with boring and ream-

ing on other work than pulleys, so long as the material is cast iron and the shape does not interfere with as ready chucking.

To determine the time for turning and polishing pulleys chart Fig. 7 is used. This shows that a pulley 36 inches diameter by 8 inches face would require 1 hour and 30 minutes; doubling the face to 16 inches would add another hour, as found by reference to the curve marked 16 inches face as against that marked 8 inches face.

Pulleys are frequently made up in larger lots with a consequent economy of time; the saving is given by the small table printed on the chart; by that, if 10 to 24 of the above mentioned 36-inch by 8-inch pulleys were to be dealt with in one lot, a saving of 15 per cent. of the 1½ hours = 13 minutes per piece would be had. It is quite usual to have one man attend to two pulley lathes; that always means a reduction in the output of each machine, fairly represented in this case by an increase of 20 per cent. in the time allowance given by the chart.

Many more charts for various operations might be given from the writer's practice, but they are all for more specialized work; on such work the results in different shops vary so widely, in accordance with the machines and fixtures provided, as to rob the charts of nearly all value to others, unless they were accompanied with a description of appliances so in detail as to be hardly practicable for these pages, from considerations of available space.

On comparing the charts given with results in the shop a difference is certain to be found; similar charts based on local experience may then be made out, or the results given on the charts may be modified in the observed ratio. This is very easily done by the laying down of a new time scale; the latter course is preferable for a time, or until a sufficient number of comparisons have been accumulated to serve as a fair basis for new charts.

The writer hopes that others may be induced to give in any form most convenient to them the times for standard operations, to the end that gradually a fund of information may be accumulated that will greatly aid in the economical turning out of work, while helping to remove some of the barriers to a mutual understanding between the workers and those who now only too frequently consider themselves the "worked."

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## VARIABLE SPEED MOTORS.—2.

WILLIAM BAXTER, JR.

A diagram of the multivoltage controller of the General Electric Company is shown in Fig. 5. In this system the voltages are in the ratio of two to one, so that when the higher voltage is used the motor velocity is doubled. Other speeds are obtained by means of field regulation, and as the motors are proportioned so as to give a variation of two to one, any velocity between those due to the two voltages can be obtained by connecting the motor with the lower voltage and introducing the proper resistance in the field circuit. The normal velocity obtained with the motor connected with the high voltage can be doubled by introducing all the regulating resistance in field circuit. From this it will be seen that a range of velocities of four to one is obtained.

The field regulating rheostat is divided into fourteen sections, and as these can be cut in or out with either of the two voltages, twenty-eight different speeds are obtained. The controller cylinder is provided with additional contacts for reversing, the speed in the reverse connection being that due to the low voltage.

In the forward motion, when the controller is moved to the first step, the middle line wire *T*2 connects with the top cylinder ring, and the line *T*3 connects with the bottom cylinder ring. The stationary contact *R*1 rests on the second cylinder contact on the first step and contact *AA*1 rests on the eighth cylinder ring on all the steps. From this it will be seen that the circuit from *T*2 will be through *R*1 to and through the starting rheostat to *R*4, thence through the blowout coil to the motor armature, through the latter to controller contact *AA*1 and through the two lower cylinder rings to contact *T*3, and thus to line wire *T*3. This connection places the motor armature in circuit with the low voltage lines. The motor field coil circuit starts from the *T*3 contact of the controller and ends at the *T*1 line wire, thus connecting the field across the high voltage mains. When the controller is in the off position, the arms *A* and *B* are in the position shown, but when the controller is moved to the first step, *A* advances to the position 1 on the field rheostat contacts, and, as will be seen, rests on the long contact that is connected with one end of the rheostat and also with the field coil; therefore, the current from *T*3 passes directly to the motor field coil without traversing any of the field rheostat. In moving through the next four steps the controller simply cuts out the starting resistance, but in the following steps, up to the 18th, successive sections of the field rheostat are cut into the field circuit. When this last named step is reached, *A* is in the position 18 to the left of the field rheostat contacts, and *B* is but a short distance to the right of the position in which *A* is drawn. The movement of the controller in passing from 18 to 19 is quite long, and during this movement arm *B* passes over the three contacts at the right of the field rheostat, and by doing so cuts out of the field circuit in four sections all the field rheostat, so that when the 19th step is reached there is no external resistance in the field. The cylinder rings of the controller, in passing from the 18th to the 19th steps disconnect *T*2 and *R*4 and connect *T*1, *R*1 and *R*2

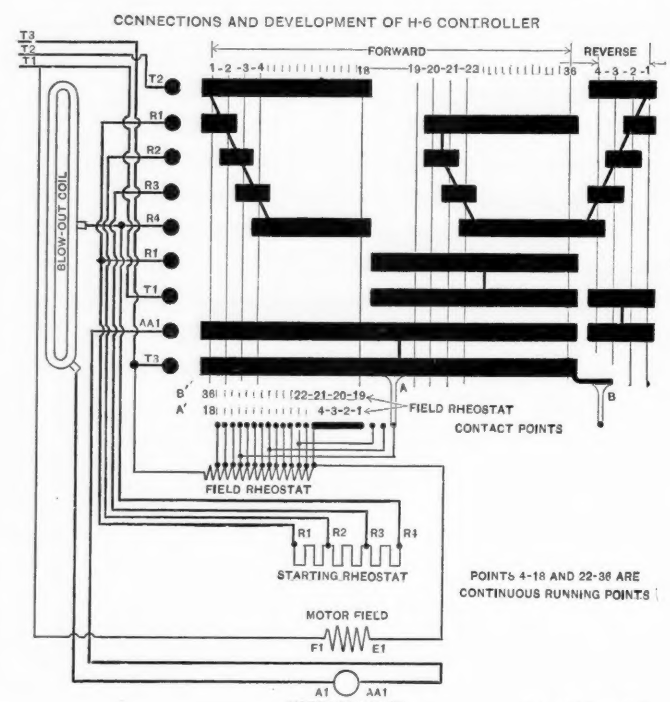


Fig. 5

thus connecting the motor with the high voltage lines and at the same time cutting in two sections of the starting rheostat. In the next three steps the starting rheostat sections are cut out, and then arm *B* begins to move across the field rheostat contacts and cuts this resistance into the field circuit section by section, the last section being cut in when the 36th step is reached.

### Variable Speed Alternating Current Motors.

The induction motor is the only alternating current machine that is suited, at the present time, for variable speed work. The speed of an induction motor can be varied by introducing resistance in the rotor, or secondary circuit, which amounts to the same thing as introducing resistance in the armature circuit of a continuous current motor. This method, which is called rheostatic control, the same as when applied to continuous current motors, is used by the General Electric Company.

The speed of induction motors can also be varied by providing two or more sources of current, each one having a different frequency. This method of control is the equivalent, in effect, of the multivoltage systems used with continuous currents, as the speed variations are proportional to the frequency changes in the same manner as with continuous currents the speed changes are proportional to voltage changes.

With the continuous current system, if only one voltage is available, additional voltages are provided by the use of one or more motor generators, which are commonly called balancers. In an alternating current system, if currents of one frequency only are available, other currents of other frequencies can be provided by the use of one or more motor generators.

While by the use of two or more frequencies different speeds can be obtained, the system has not come into use except perhaps in a few isolated cases; it is not a standard system, and controllers to operate with it are not regularly made.

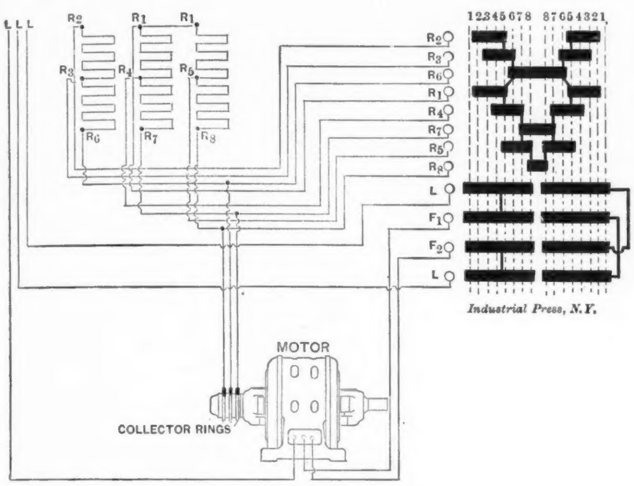

Fig. 6.

Another way of changing the speed of induction motors is by changing the number of poles of the motor; thus if the motor field, or primary winding, is arranged to develop say sixteen poles, and run at five hundred revolutions with this number of poles, it can be made to run at one thousand revolutions by changing the number of poles to eight. This method of changing or doubling the speed of induction motors is used by the General Electric Company. The pole changing method of control combined with the rheostat method, will give as wide a range of variation as may be desired, it being from the highest velocity, which is obtained with the field connected for the small number of poles down to the minimum, which is obtained with the field connected to give the larger number of poles, and all the rheostat cut into the secondary circuit.

The diagram, Fig. 6, shows the arrangement of the rheostat controller for induction motors. This controller, as will be seen from the development of the cylinder rings at the right side of the diagram is of the reversing type, and will give the same number of speeds with the motor running in either direction. If the rheostats are made of sufficient capacity, throughout, to carry the working currents continuously, the controller can be left in any position, and thus eight different speeds can be obtained. Generally, however, the first few steps are used simply for the purpose of starting, and only three or four of the last positions are running steps.

Fig. 7 is a wiring diagram of a pole changing controller of the reversing type. This controller as will be noticed moves through two steps only, the first one connects the line wires with the motor wires 1, 2, 3, and the second step connects the line wires with motor wires 4, 5 6. When the controller is moved to the first step the motor is connected so as to have the larger number of poles, and run at the lower velocity. When the controller is moved to the second step the motor poles are reduced to one-half the number, and the velocity is doubled.

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### TWO QUERIES.

A subscriber wants information on the proper proportions of bells. Another wants similar data regarding steam whistles. Contributions on either or both these subjects will be acceptable and doubtless will be appreciated by many, as there seems to be nothing published on either subject that is generally available.—Editor.

## THE LATENT HEAT QUESTION.

### IS STEAM THE BEST VAPOR FOR POWER PURPOSES?

In the effort to improve the steam engine the proposition is often advanced to substitute the vapor of the more volatile liquids, like chloroform, ether, alcohol or carbon bi-sulphide for the vapor of water. A short time ago we were approached by the inventor of an ether motor who was looking for information, which suggests the topic at this time.

Although there have been many motors of this character devised and actually constructed—most of which have, for one reason or another, proved failures—the fact that these volatile liquids are so easily vaporized and attain such high pressures without absorbing an enormous quantity of heat—such as is represented by the latent heat of steam—makes them appear attractive. Their quality of vaporizing at low temperatures has led to the development of the binary vapor engine, which has met with some degree of success. The binary vapor engine has two cylinders, similar to a compound engine. One cylinder is for steam and the other for the vapor from some volatile liquid, usually ether. The exhaust steam from the first cylinder passes into a form of receiver which acts as a condenser for the steam and as a boiler for the volatile liquid, the liquid being on one side of the tubes and the steam on the other side. The volatile liquid acts like condensing water in condensing the steam, and the heat from the steam is sufficient to vaporize the fluid for use in the vapor cylinder.

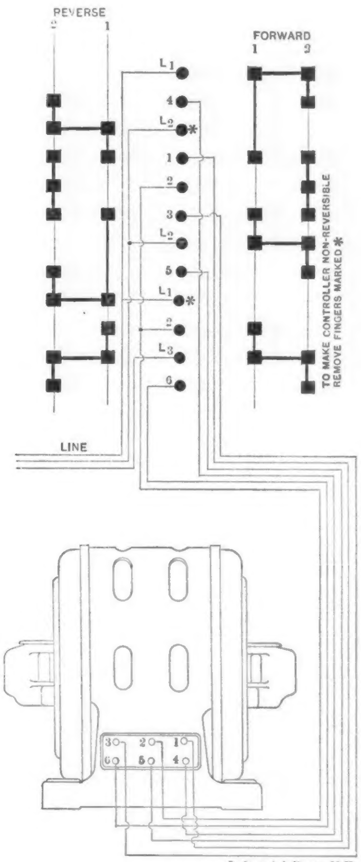


Fig. 7.

It would appear that if vapors from volatile liquids are to be of much value for power purposes, it would be in some such way as the foregoing. The very fact that they vaporize at low temperatures means that when used in a single cylinder engine, the back pressure at exhaust would still be so high as to impair the economy of the engine, unless a large amount of condensing water is provided at very low temperature.

#### Characteristics of Steam and Chloroform.

In instituting comparisons between steam and the vapors of volatile liquids it will be easier to use French units instead of English units, because most of the tables of the properties of these vapors are published only in the French system. Taking for illustration, steam at 160 degrees C. (equivalent

to about 90 pounds pressure), assuming it to expand in an engine cylinder down to 40 degrees C. (or about 1 pound absolute pressure) and comparing it with chloroform under similar conditions, we find that the latent heat of the steam at the higher and lower temperatures respectively is 494 and 579 calories, while the latent heat of chloroform is only 51 and 63 calories, or only about one-tenth that of the steam. On the other hand, the pressure of the chloroform at the higher temperature is about 169 pounds, or nearly double that of the steam. When it is considered that it is pressure which makes the piston move, and that so large a proportion of the latent heat of steam passes out through the exhaust pipe of an engine, it is no wonder that these volatile vapors have proven attractive. A few calculations, however, will show that steam is, after all, the most satisfactory substance to use, especially when it is considered that it comes from water—a universal substance which is non-inflammable and does not involve a one-quarter part of the danger in its use that must be experienced with the other substances. Stated briefly, steam will produce the best results per unit weight; but a vapor like chloroform which has so high a pressure for a given temperature, and consequently occupies so small a space in proportion to its weight, will produce the greater power per unit volume. That is, while a greater weight of chloroform, for example, would theoretically be used to produce a given power, an engine using chloroform would produce more power than a steam engine with the same size cylinder.

### Chloroform is Better, Theoretically, but not Practically.

In Peabody's Thermodynamics, to which the reader is referred, calculations upon the available power per unit weight and unit volume of steam and chloroform are carried out as outlined below. The attempt will not be made here to give either the theoretical basis for the calculations, or even the steps in the process, as a brief statement of the results will answer our present purpose.

The theoretical consumption of an engine may be roughly calculated by multiplying the latent heat of the vapor at the temperature at which it is used by the efficiency of the engine, calculated by the well-known method of dividing the difference of absolute pressure by the absolute higher pressure. For steam at 160 degrees C. expanding to 40 degrees C., we find the efficiency to be .28, and the heat converted into work, 137 calories. For chloroform working between the same temperatures the efficiency is, of course, the same, being independent of the working substance, but the calories converted into work are only about 14, or nearly ten times as much in one case as in the other.

But if we are to consider volumes instead of weights calculation shows that for an engine having a cylinder containing one cubic meter in volume only 8.7 calories would be converted into mechanical work per stroke when steam is used, as against 34 for the chloroform. This is because of the very small volume occupied by chloroform vapor per unit weight.

To make the comparison fairer, however, suppose the steam to be used at the same *pressure* at which the chloroform is used instead of at the same *temperature*. Then we find 151 calories converted into work per kilogram, and about 10 calories per stroke of the engine. These figures show that in spite of their disadvantages the vapors of volatile liquids have some advantages from a purely theoretical standpoint. It seems a reasonable conclusion, however, that the theoretical advantages of the volatile liquids are many times over-balanced by their practical disadvantages, such as cost, inconvenience, danger, high exhaust pressure, and unstability; the latter due to low latent heat, which means low reserve power.

### Latent Heat is not a Disadvantage.

Probably this question of the latent heat is what has led so many to investigate the value of the vapors of volatile liquids for power purposes. The large amount of latent heat that passes off in the exhaust in a steam engine has been looked upon as lost and it has been reasoned that a vapor having less latent heat to lose would be more efficient. Some years ago, however, the question of substitutes for steam was quite thoroughly presented by Mr. George H. Babcock, in a paper before the American Society of Mechanical Engineers. He showed by simple calculation that latent heat is not necessarily wasted heat; or, in other words, that if all the heat received in evaporating water were expended in elevating the temperature, instead of a large share of it going into the latent condition, we should not be able to turn into work nearly as large a proportion of the heat supplied to the steam as under actual conditions. Assuming that steam be supplied at 220 degrees temperature—75 pounds gage pressure—and that it exhausts at about 100 degrees temperature—or 28 inches vacuum—the efficiency when working on a perfect cycle would be .28 and the heat expanded per pound of steam would be 220 (heat in the water) $\times$ .475 (specific heat) $\times$ 772 $=$ 80,674 foot pounds; 28 per cent. of this is 22,588, which is equivalent to 87.6 pounds of steam per horse power hour—rather an extravagant expenditure for a perfect engine!

A crude but rather effective analogy to the latent heat of steam is the weight of the water for driving a water motor. The height of the source of supply may be said to correspond to the temperature of steam; the weight, to the latent heat, and the pressure which compels the motor to rotate corresponds to the pressure of steam. It is evident that this pressure is dependent both on the height of the source of supply and the weight of the water, and in a similar manner the pressure of steam is dependent both upon the temperature and the latent heat of the steam.

It is by means of the latent heat that the pressure can be sustained after the point of cut-off, to the extent to which it is throughout the stroke of the piston; and it is because of this latent heat that so large a proportion—small though it is—of the heat units put into the steam by the furnace fire can be taken out again in the form of mechanical work. While the greater part of the latent heat is, of course, given up by the exhaust, it is not conceivable that the excellent and economical results produced by the steam could be obtained in any other way.

Better than theoretical considerations, however, are actual tests; and in the discussion that follows Mr. Babcock's paper, which was presented eighteen years ago, Prof. Trowbridge, of Columbia University, quoted results from a test upon a bisulphide of carbon apparatus. From results of the tests the efficiency was found to be .167; and from results of a test of a condensing steam engine under similar conditions the efficiency, strangely enough, figured out to .157, or practically the same—a remarkable coincidence, when it is considered that each of the results depended upon experimental data. The comparison verifies the law that the efficiency of an engine is independent of the working fluid, although, of course, this does not take into account the action of the cylinder walls in producing condensation and re-evaporation in the cylinder.

* * *

A short time ago the work of demolition of the great Burden water wheel at Troy, N. Y., was commenced, but the action aroused such a great amount of opposition that the work was stopped, and an effort is being made to have the wheel restored and allowed to stand to the memory of Henry Burden, who was its designer and builder, and whose iron mill it operated for many years. The wheel is said to be the largest construction of the kind ever erected and therefore it has a double interest. The wheel is 60 feet in diameter and 20 feet wide. It has 36 huge buckets. The journals of the great wheel are 16½ inches in diameter and 18 inches long and it has 264 spokes, each 1½ inches in diameter. The wheel was first put into operation in 1849 and ran almost continuously until 1895, when the works were abandoned. Making two and a half turns per minute, this wheel ran the entire plant, which consisted of one rotary squeezer and muckbar train, five 9-inch trains for rolling horseshoe, and rivet iron, five or six rivet or spike machines, about thirty punching machines, machine shop roll lathes, shears, and other machinery called for about a rolling mill. At this plant Henry Burden invented and improved a number of processes. The most important and the one for which he is chiefly known is the horseshoe making machine, which, was one of the greatest inventions, of the time. Burden also invented the rotary squeezer, which is in use in all mills where iron is made by the puddling process.—*Scientific American.*

## TESTS ON A 4,000 H. P. STEAM TURBINE.

In connection with the Dresden Exhibition of German Civic Life, the municipal electricity works of Frankfort-on-the-Main published some tests made on a 4,000 horse power steam turbine (system Brown-Boveri-Parsons, Switzerland) which had been installed in one of their central stations. The turbo-dynamo is designed to operate under a steam pressure of 13 atmospheres, using superheated steam at 300 deg. C. and giving outputs as high as 2,600 kilowatts at a pressure of 3,000 volts, 1,360 revolutions per minute. It is 16.5 meters in length, 2.5 meters in breadth and 2.5 meters in height. All the parts of the steam turbines are easily accessible, the whole of the interior becoming visible through unscrewing the upper cylinder cover. The engine is of very easy and simple operation and superintendence, only 15 minutes being necessary to preheat the turbine cylinder from the cold state. The regulation of the turbine is extremely accurate, the steam requiring to traverse the turbine only a fraction of a second, which makes the effect of controlling on the only inlet valve felt instantaneously. Though the steam enters by puffs, the uniformity in the working of the turbine is remarkable. The turbo-alternator works readily in parallel with other alternators, operated by reciprocating engines, the more so as the rotating magnet field is analogous to the rotors of asynchronous motors. The following table records some experiments in the course of normal operation, the figures stated being average values:

| Steam Pressure before Inlet Valve. (Atmospheres) | Temperature of Superheated Steam. (Centigrade.) | Load in K.W. | Vacuum per cent. of Barometer Reading. | Steam Consumption kg/KW. Hour. |
|---|---|---|---|---|
| 12.63 | 298 | 1945 | 93.2 | 7.20 |
| 12.8 | 295 | 2518 | 91.8 | 7.09 |
| 10.6 | 312 | 2995 | 90.0 | 6.70 |

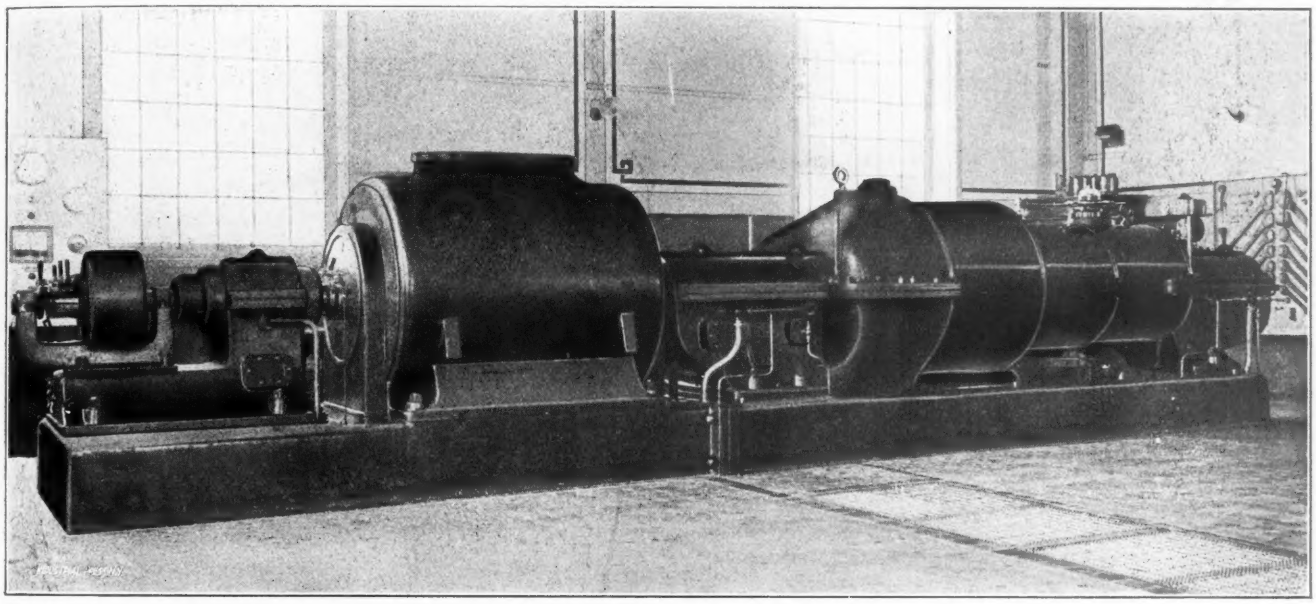
According to the contract, the steam consumption was to be not higher than 7.2 kg. for a superpressure as high as 12.8 atmospheres, a superheat of 300 deg. C. and a load of 2600 KW. From the above table it is inferred that the actual steam consumption is much below these figures, showing the steam turbine to work at least as economically as the most perfect reciprocating engines of the same size. A. G.

[The foregoing illustration of a leading type of steam turbine, as made by the famous firm of Swiss engineers, and the results of authentic tests upon a large turbine of this make, are of general interest. The data, however, will be more intelligible if given in English units, and we have therefore converted the figures to this form in the table below:

| Steam Pressure, lbs. sq. inch. | Temp. of Steam, Fahr. | Degrees of Superheat, Fahr. | Load in KW. | Vacuum, Inches of Mercury. | Steam Consumption, lbs. per K.W. Hour. |
|---|---|---|---|---|---|
| 185.7 | 568.4 | 193 | 1945 | 28 | 15.8 |
| 188.2 | 563 | 186.4 | 2518 | 27.5 | 15.6 |
| 155.8 | 593.6 | 232.4 | 2995 | 27 | 14.7 |

Taking the best result—14.7 pounds per KW hour—and comparing it with the best results from reciprocating engines, will show that the turbine in its present state of development is just about equal in efficiency to the reciprocating engine. The efficiency of the turbine, however, is nearly uniform under a varying load, while the efficiency of the reciprocating engine varies greatly with the load; or in other words, the average efficiency of the reciprocating engine is very much lower than of the turbine. One of the greatest losses in the turbine is due to the leakage of steam through the passages between the wheel blades and guide vanes, and if this should be remedied we may look for a further improvement in turbine efficiency.

Referring to the last test quoted above, let us assume that the generator of this turbine had an efficiency of 95 per cent. The consumption of 14.7 pounds of steam per kilowatt-hour is derived from the measured output of the generator and hence what would be the equivalent brake horse power of a steam engine under similar conditions would be determined by dividing 14.7 first by 1.05 and then by 1.34, the number of horse-power hours equal to one kilowatt-hour. This gives us 10.48 pounds of steam per horse-power hour, certainly a remarkably fine performance when measured in brake horse power. Now assuming the frictional loss in a steam engine to be 10 per cent. of the total power developed, the consumption of an engine which used 10.48 pounds of steam per brake horse power per hour would be $10.48 \div 1.10 = 9.5$ pounds per indicated horse power per hour. This is rather better than the best results from reciprocating engines using superheated steam; but tests thus far have been from comparatively small engines, while the turbine figures are from a 4,000 horse power unit. With a reciprocating engine of corresponding size, using superheated steam, we should expect the consumption at normal load to be as low as that of the turbine, but as previously stated, its average rate would be much higher.—Editor.]



Brown-Boveri-Parsons Turbine.

* * *

It is well known that the automobile is, to a large degree, a helpless machine in freshly fallen snow and that it climbs hills with great difficulty even when the snow is well packed. It appears that the slipping of the wheels is largely caused by the tires becoming heated by internal friction so that the snow is melted next the tires, which, of course, puts them in the very best condition to slip. The usual plan followed when driving the automobile in snow is to wind the tires with rope, which serves the double purpose of presenting a corrugated surface and of not transmitting the heat directly to the snow. Internal tire friction is a serious factor in the operation of high-speed machines, the tires frequently becoming so hot as to be ruined, either by disintegration of the fabric, or in the case of pneumatic tires, by bursting because of the expansion of the air.

## NOTABLE INSTALLATION OF THE RENOLD SILENT CHAIN.

What is said to be the largest single installation of chain drive ever made, was recently put in the Arlington Mills, Lawrence, Mass., by the Link-Belt Engineering Co., Philadelphia, Pa., the total equipment aggregating 1,056 horse power, and all being the Renold silent chain, which the company controls in this country.

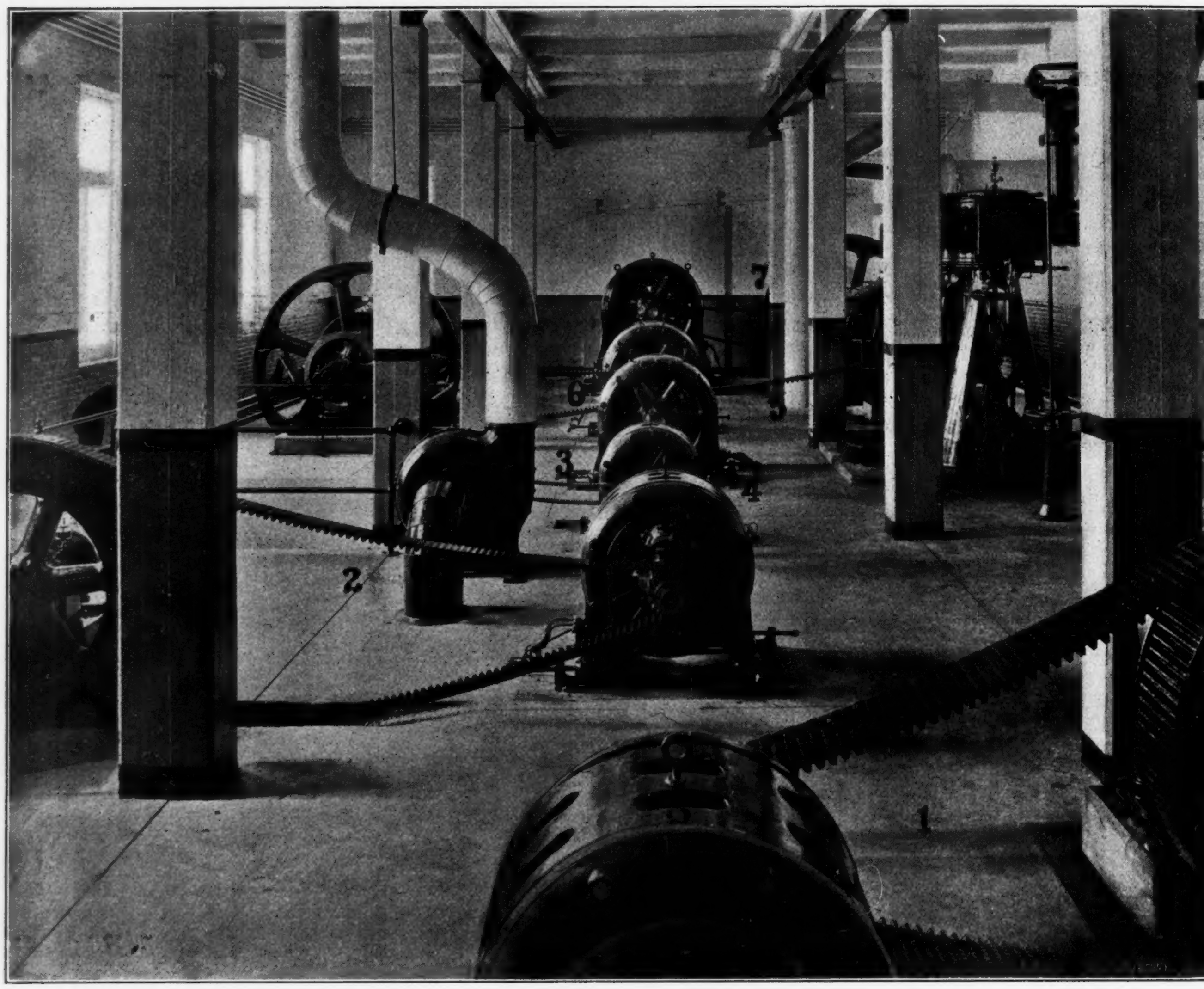


Fig. 1. Over 1000 Horse-power Transmitted with Renold Chains in one Installation.

Fig. 1 shows a general view of the installation, there being seven machines in all that are equipped with chain drive. They comprise a 100 horse power gas compressor (1); 60 horse power air compressor (2); 6 horse power exhaust fan (3); 30 horse power centrifugal pump (4); 100 horse power exhauster (5); 260 horse power auxiliary blower (6); and 500 horse power gas compressor (7). It is estimated that there is a clear saving of 25 per cent. of power made by the use of the chain drive; moreover, there is no danger from fire by sparking as would be the case with leather belts in this instance, since there is a large quantity of naphtha handled in this room.

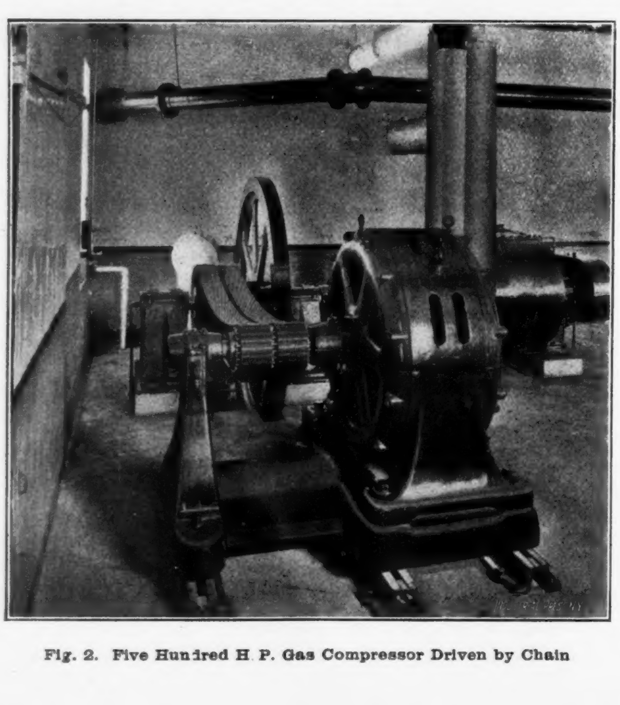


Fig. 2. Five Hundred H. P. Gas Compressor Driven by Chain

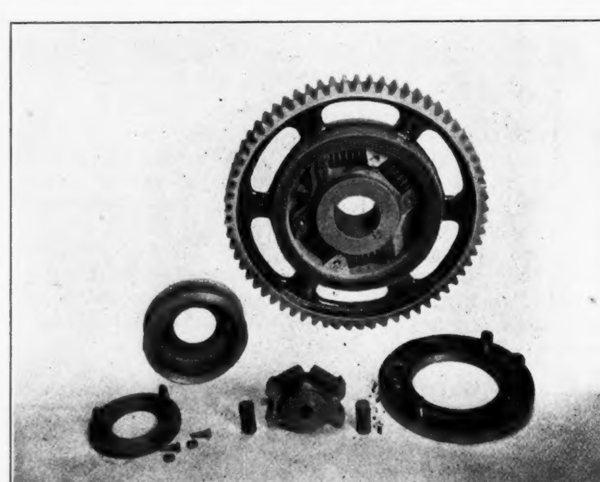


Fig. 3. Spring Compensating Centers for Gears.

Fig. 2 shows the 500 horse power gas compressor drive individually and close at hand. This is the latest development in the double strand drive, that is, the employment of two driven wheels side by side, each having spring compensating

centers. The object of the spring compensating center device is to absorb the shocks and pulsations incident to a long heavy chain drive and to correct the errors of angular velocity, which is important in reciprocating machines. In the case of the double strand drive the compensating device also prevents unequal wear of the chains, balancing the load between them and making the wear equal.

Fig. 3 shows the spring compensating center clearly in detail for both a driving and a driven gear, the construction being essentially the same in both cases. It will be observed that one of the gears is shrouded or flanged at the sides while the other is plain. The one having the flanges at the sides is the driven gear, it being necessary in all cases to provide flanges for the driven gear, but this is not necessary for the driver save when the center distances are long. In Fig. 1 it will be noted that the pinions of the electric motors are plain, while the driven machines have flanged gears.

* * *

## CENTENARY OF THE LOCOMOTIVE—1803-1904.

A. R. BELL.

One hundred years ago, on February 12, 1804, occurred an event which was without parallel throughout all the ages, in the results which accrued. On that day the first steam railway locomotive made a trip of nine miles along a tramway with a train containing a load of iron weighing 10 tons exclusive of the wagons, and 70 people, at a speed of five miles an hour (whilst traveling), though the actual journey, owing to slight accidents, extended over four hours and five minutes. The scene of the performance was the Pen-y-darren Tramroad, near Merthyr Tydvil in South Wales, extending from the back of the Plymouth works at Pen-y-darren to the Navigation at Plymouth. A wager laid between Samuel Homfray, the owner of the road, and his friend, Richard Crawshaw, in which £500 a side was staked on the possibility of conveying a load of bar iron by steam power from the works to the water side, encouraged the experiment to be undertaken. This wager was actually secured for Mr. Homfray by a Cornish engineer and mechanic, Richard Trevithick, who was at that time employed in erecting a forge at the iron works at Pen-y-darren, and who designed and erected the first practical railway locomotive at the company's works. Prior to that he had, in co-operation with his cousin, Vivian, patented the idea of a high-pressure steam engine—as distinguished from the low-pressure condensing engines then in use for mining operations—and had built a road locomotive in accordance with that idea, and a railway locomotive for use at Coalbrookdale. If the latter ever accomplished a trip along a railway is open to doubt. At all events, the Welsh engine is the earliest of which any authentic particulars are forthcoming as having fulfilled the purpose for which it was designed.

The patent taken out by Trevithick in 1802 specified an "improved steam engine to give motion to wheel carriages of every description." Passing over the details of the gearing designed to give forward or backward motion to the carriages at will, we find that a force pump was provided for feeding the boiler. An important item refers to the question of adhesion. Thus, while in certain cases it was suggested to make the external periphery of the wheels uneven, by projecting heads of nails or bolts, or cross grooves, or fittings to railroads, when required; or in cases of "hard pull" to cause a lever, bolt, or claw to project through the rim of one or both of the said wheels, so as to take hold of the ground"; yet it was specially mentioned that "in general, the ordinary structure or figure of the external surface of these wheels will be found to answer the intended purpose."

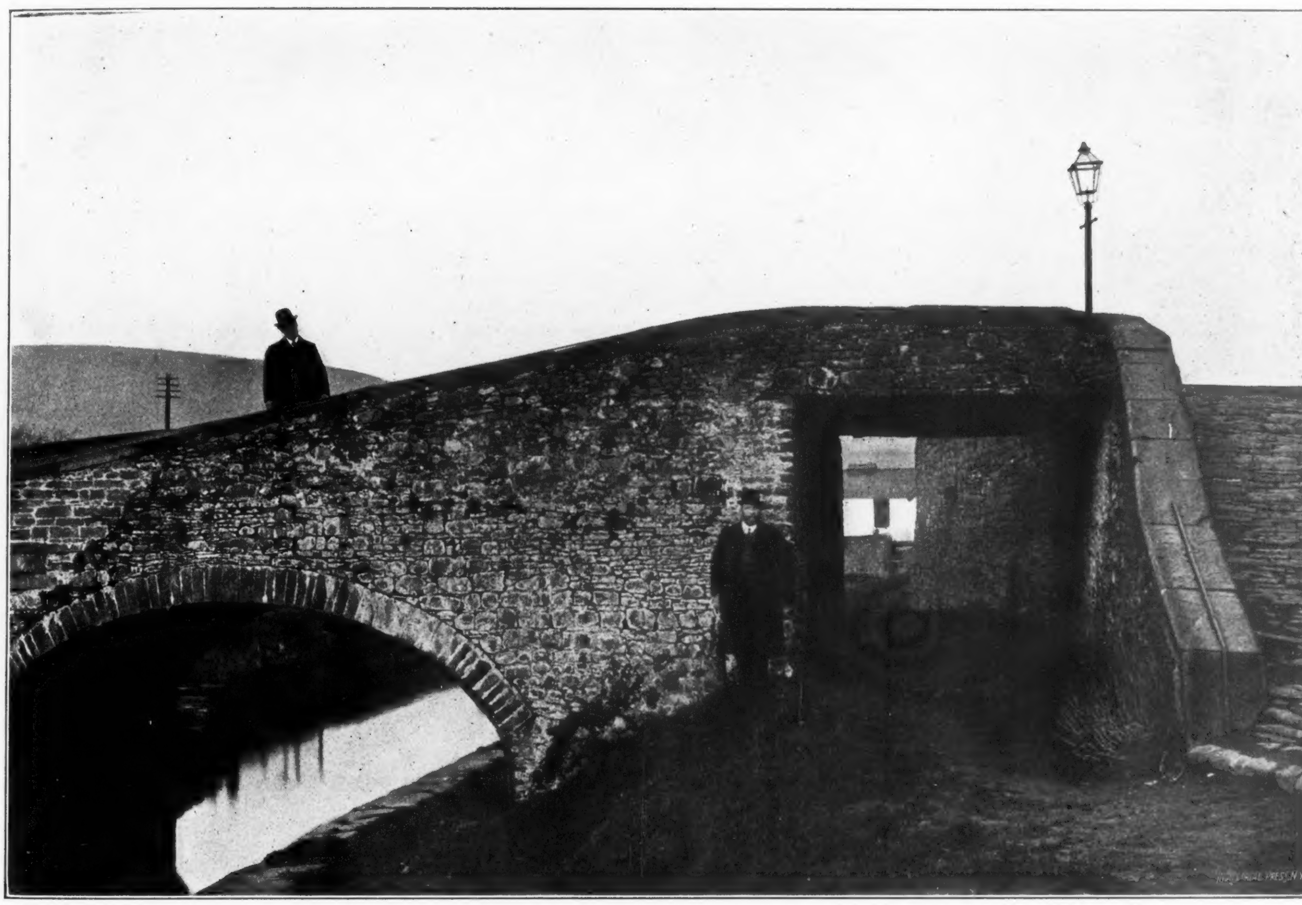


Fig. 1. On Feb. 12, 1803, the first locomotive made a trip of nine miles, taking four hours. The tramway passed under the old bridge shown above at Pen-y-darren, Wales, and the brick chimney of the locomotive was knocked down at this point

Referring to details embodied in the engines built by Trevithick, but not mentioned in the specification, the following occur. The boiler was cylindrical and contained an internal flue firebox, and return flue tube. The cylinder was partially contained within the upper part of the boiler, that portion which was not so contained being provided with a steam jacket. The waste steam after leaving the cylinder was taken into the chimney, and thus provided a steam blast. This point has often been misunderstood, since in the patent specification and in the earlier road locomotives, bellows worked from the piston rod or crank were provided for. There is no room for doubt, however, that in practice Trevi-

thick was the inventor of the exhaust up the chimney. It has been said truly enough that "as a true inventor no name stands in so close connection with the locomotive engine as that of Richard Trevithick. It was he who first broke through the trammels of Watt's system of condensation and low, if not negative, pressure; it was he who first employed the internal firebox and internal heating surface; he was the first to create or promote a chimney draft by means of exhausting the steam through it; the first to employ a horizontal cylinder and cranked axle, and to propose two small cylinders with the cranks at right angles to each other; the first to surround the cylinder with hot air; the first to draw a load by the adhesion of a smooth wheel on a smooth rail bar; the first to make and work a railway locomotive engine."

The foregoing claims are in no degree minimized by the fact that Richard Trevithick failed to make a commercial success of any of the few locomotives that he designed and built. He was an inventor, and not a man of business, without the instinct that caused George Stephenson to battle against prejudice and conservatism until he won. Others

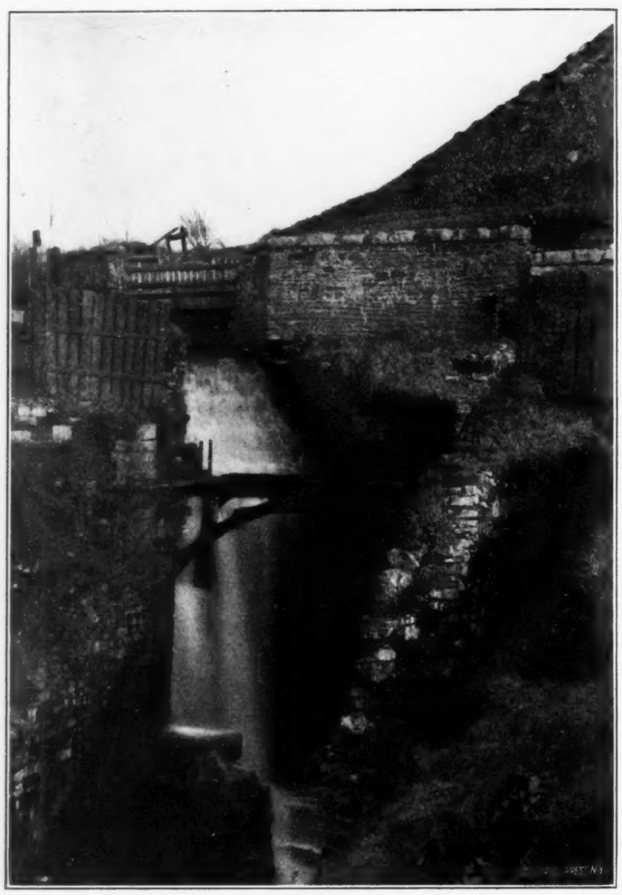


Fig. 2. An old Bridge on the Pen-y-darren Tramway.

reaped what Trevithick had sown, and the world at large always apt to credit those who succeed, is in danger of forgetting the debt which it owes to the Camborne engineer.

Of the first railway locomotive, which won the wager for Samuel Homfray, it is unfortunate that no really authentic drawing seems to be in existence. The illustration, Fig. 5, which is generally assumed to be the Pen-y-darren engine, is derived from an original drawing made by Trevithick himself, and dated December, 1803. Such details as the return flue boiler, the small chimney, the horizontal steam jacketed cylinder and the smooth wheels can readily be seen, but generally accepted accounts of the engine built for the Merthyr train road speak of "a dwarf body placed on a high framework, constructed by the carpenter of the works in the roughest possible fashion. The wheels were equally rough and large, and surmounting all was a huge stack, ugly enough when it was new but in after times made worse by whitewash and rust." This chimney was built of brick, and it is stated to have collided with a bridge en route, promptly collapsing.

Richard Trevithick was born at Camborne in 1771 and died in 1833. His labors were chiefly among mining engines, and on these, as in the locomotive and steam engines generally, he left his mark. He is credited with the introduction of the Cornish and Lancashire type of boiler, the internal furnace, the non-condensing steam engine, the portable engine, the feedwater heater and boiler feed pumps, the locomotive and

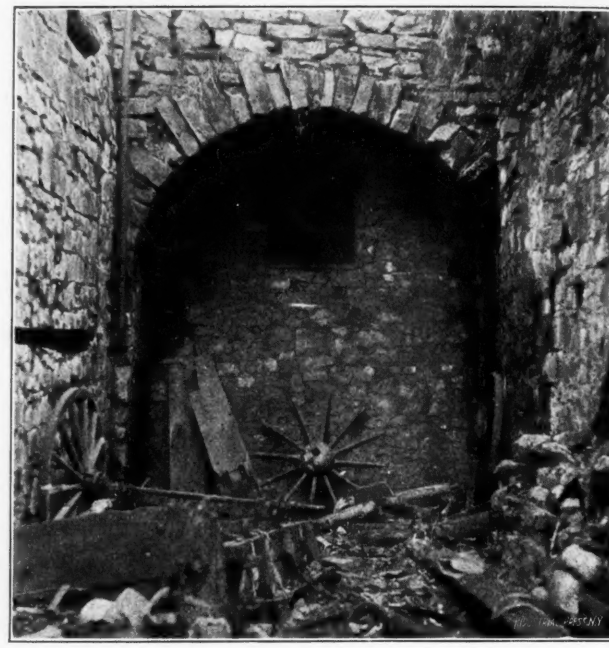


Fig. 3. Remains of Old Tunnel at Merthyr, through which Trevithick Locomotive ran on its Trial Trip—now used as a Store for Old Metal.

the blast pipe—a sufficient catalogue to make it seemly that his memory should be preserved green.

[The print sent by Mr. Bell showing "Trevithick's high-pressure tram engine" or locomotive, bears the following inscription, but, unfortunately, no date is given:


Fig. 4. Pillar of an old Crane, at Navigation—made in 1804 by Trevithick.

"Trevithick's high-pressure tram engine, so designated in the original plan, was constructed partly in Cornwall and partly at Pen-y-darren Works by Richard Trevithick, Esq., engineer for Samuel Homfray, Esq., proprietor of the Pen-y-darren Iron Works, Merthyr Tydvil, who, while discussing

the principles and feasibility of locomotive steam engine power with Richard Crawshaw, Esq., of the Cyfartha Iron Works, made a bet of one thousand guineas that he could convey by steam power a load of iron from his works to the Navigation House (nine miles distant) along the basin tramroad; which he effected by this engine and won his wager although the heavy gradients, sharp curves, and frangible nature of the cast iron trackway operated against the return of this ingenious though rudely constructed machine with the empty trains—hence its discontinuance. As may be perceived, the exhaust steam discharged into the stack, and the wheels are combined; thus to Trevithick is the credit due for the application of those two principles to locomotive engines.

"Rees Jones, who aided in the fitting, and William Richards, its driver, are still alive [date not given]; the former when shown the plan, instantly identified it, and the latter, now in his 85th year, has worked no other than Trevithick's high-pressure engine. To this day portions of the old engine exist in the one he now works at Pen-y-darren, and during a period far beyond half a century, never having had an accident with his boiler.—Thos. Ellis, Engineer, Ty Mawr, Porty Prid, Glenmorganshire."—Editor.]

* * *

One of the alleged difficulties of profitably operating street railways is that certain conductors will engage in the pernicious practice of "knocking down" fares. Whether the loss sustained by the railway companies is large in the aggregate as compared with the gross earnings, we have no means of knowing, but do know that the companies are continually devising ways and means for discouraging the practice. The fare register is universally employed, but this works only by the hand of the conductor, and if he is of the type that letteth not his left hand know what the right hand doeth, the register registereth not. To check this unprofitable practice—to the street railway companies—"spotters" are employed to travel as ordinary passengers and keep "tabs" on the conductors. It is alleged that the spotters on the Brooklyn Rapid Transit lines receive $2.50 a day each to spend for fares, in addition to their regular pay. This system of espionage is very irritating to employes and often works gross injustice; the spotters are expected to "earn" their wages, and if conductors are too honest the job of the spotter languishes. Hence there may be good basis for the allegation that false reports are sometimes made, whereby innocent men are made to suffer. Why could not the trading stamp plan be successfully employed by the street railway companies to promote honesty among their conductors? Let them give each conductor coupons equal in face value to the nickels he turns in. If these coupons were redeemed on about the same basis as the popular trading stamp the practice would supplement the other checks at small expense and might prove very popular with the men.

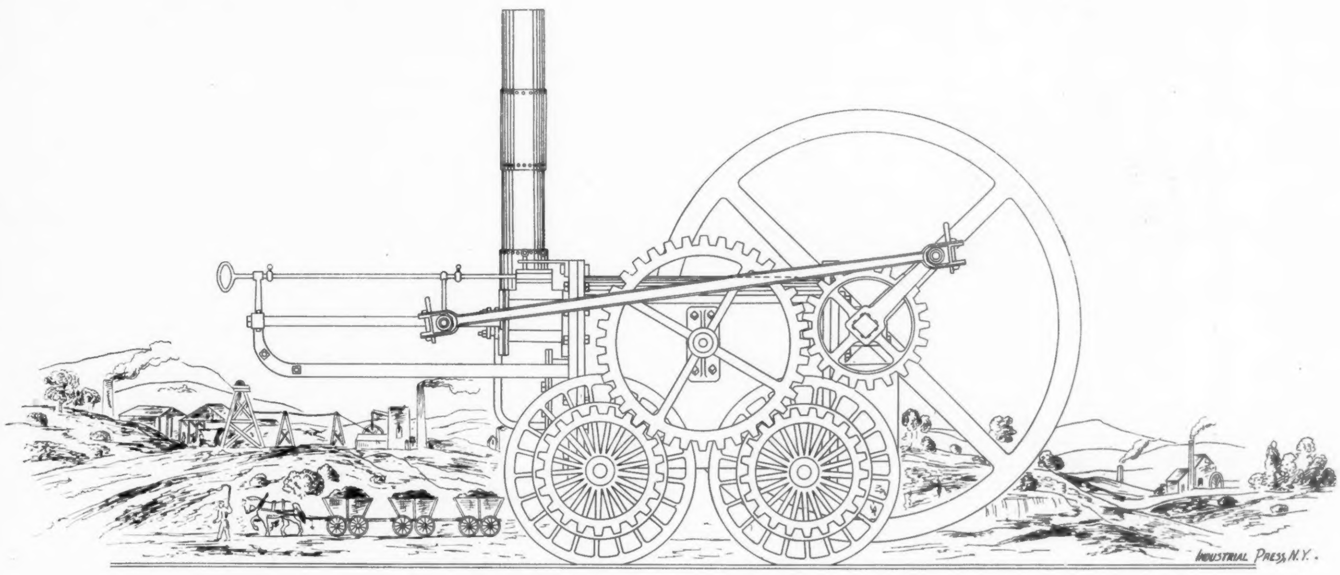


**Fig. 5. Trevithick's "High-pressure Tram Engine. (From an old Drawing.)**

## NOTES FROM THE PLUNGER ELEVATOR COMPANY.

### NOVEL HYDRAULIC PRESS—THREE-WAY VALVE.

At the works of the Plunger Elevator Co., Worcester, Mass., there are two hydraulic presses for straightening the steel tubes used for the elevator plungers. In this type of elevator the steel cylinder is sunk perpendicularly in the ground, a hole first being driven by a process similar to that employed in driving oil wells. The cylinder is of a length equal to the total rise of the elevator; and the plunger, which is turned and polished on the outside, runs in this cylinder, being supported laterally only by the stuffing box at the top and a spring sliding support at the bottom of the plunger which keeps it central so that it will not rub upon the rough interior surface of the cylinder. The elevator is made to travel upward under the pressure of water pumped into the cylinder; and it travels downward when the water is allowed to escape from the cylinder. The car which is attached to the top of the plunger has a rigid support under it, consisting of the steel plunger and the column of water in the cylinder. The weight of the plunger is partially balanced by cables attached to the elevator which pass over sheaves at the top and from which counterweights are suspended.

For the successful operation of such an elevator, especially on high lifts, the plunger must be accurately finished, and it is necessary to remove the bends in the tubing before turning. In Figs. 1, 2 and 3 are views of the press used for this purpose, which is the design of Prof. Geo. I. Alden, formerly of Worcester Polytechnic Institute. The press combines the principle of the hydraulic press with that of the double toggle joint press, as shown clearly in the smaller photograph reproduced in Fig. 2. Referring to Fig. 3 the two hydraulic cylinders are supported at their inner ends by the pins connecting each pair of links at the center, and at their outer ends by the swinging links *L L*. The two pistons, one in each cylinder, are connected by a piston rod as in sectional view, Fig. 3, and the cylinders move horizontally upon the pistons under the influence of water pressure, causing the toggle joint to open or close, as the case may be. When water is admitted to the inner ends of the cylinders the cylinders move toward each other, bringing the links of the toggle joint together and forcing down the plunger of the press. When water is admitted to the outer ends the cylinders are forced apart, raising the plunger of the press. The extent to which the cylinders can move toward each other, and hence the distance that the plunger can move downward, are regulated by the screw and handwheels shown in the sectional view of Fig. 3. It is necessary, of course, to have a flexible pipe connection with the cylinders, and this is done by using lengths of wrought-iron pipe having swivel joints, as illustrated in the general view, Fig. 1.

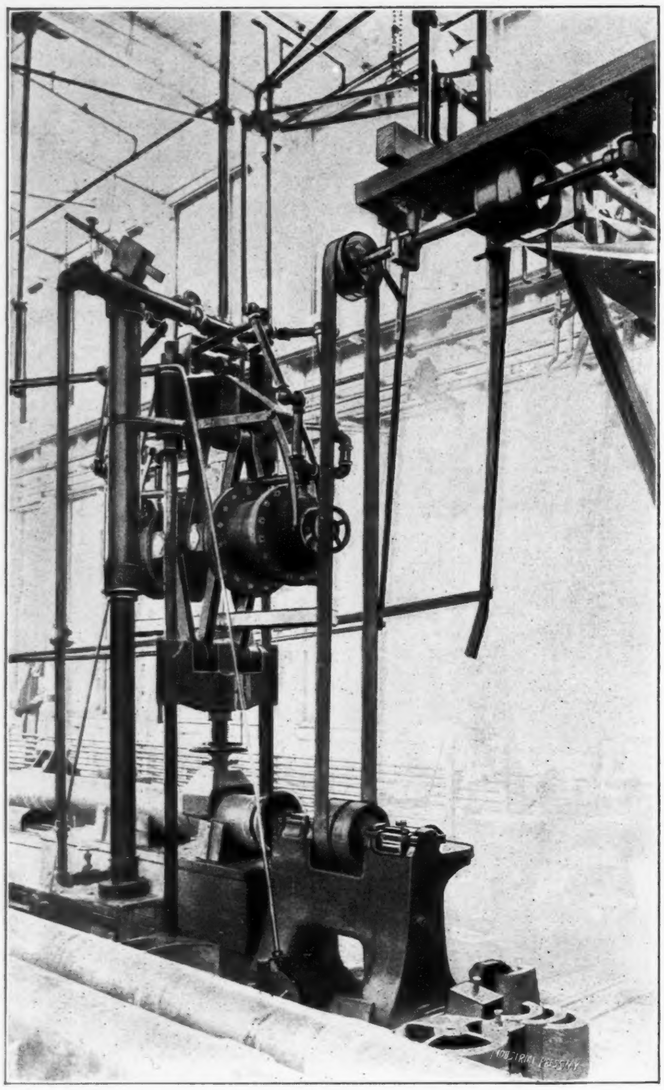


Fig. 1. Hydraulic, Toggle-joint Press.

The press operates under the pressure of an accumulator, which is shown in Fig. 1, at the left. The pipe to be straightened is supported upon cone centers, one of which is upon the spindle of a stationary headstock and the other upon a movable tailstock, so as to accommodate a pipe of any length. The pipe itself is supported upon a carriage which runs upon a track so that it can be located midway between the head and tail centers, and the press also travels upon a track so that the plunger can be brought to bear at any point on the pipe. These details are clearly brought out in Fig. 3.

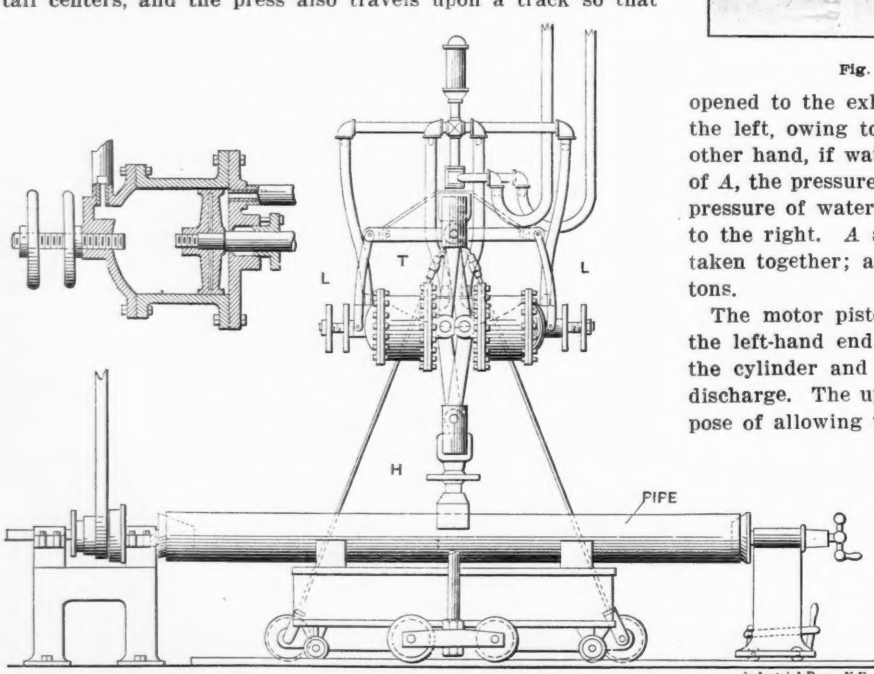



Fig. 3. Side View of Press.

### Description of Three-way Elevator Valve.

The most interesting feature of the plunger elevator is the controlling valve by which water is admitted to, or discharged from, the cylinder. This valve is shown in Fig. 4, and is used in connection with two stop valves—one for the supply, and one for the discharge—which are actuated by the elevator when it reaches its extremes of travel at the top or bottom of the shaft. The controlling valve is actuated by the attendant in the car in the usual manner.

The valve has three openings—one at *E* to the supply pipe, one at *F* to the elevator cylinder, and one at *G*, which is the discharge or exhaust opening. There are three pistons, lettered respectively *A*, *B*, *C* and *D*, which are all connected. Pistons *B*, *C* and *D* are for the purpose of admitting water from the supply pipe to the elevator cylinder which occurs when they move to a position at the right, or for connecting the elevator cylinder with the discharge opening when the pistons are in a position at the left. When in mid-position, as shown in the engraving, water can neither pass to or from the elevator cylinder and the elevator is held at rest wherever it may be located.

These pistons *B*, *C* and *D* are moved to the right or left as required, by water pressure acting upon the two faces of piston *A* and the left-hand face of piston *B*. The space between *A* and *B* is always filled with water under pressure, which comes from the supply pipe *E*. Inasmuch as the diameter of *A* is larger than the diameter of *B* it is evident that if the space in the cylinder at the left of *A* (marked *R*) were opened to the exhaust, the four plungers would be forced to the left, owing to the unbalanced pressure upon *A*. On the other hand, if water were admitted to the space *R*, at the left of *A*, the pressure upon this piston would be balanced and the pressure of water against *B* would cause the pistons to move to the right. *A* and *B* may be considered as motor pistons, taken together; and *B*, *C* and *D* taken together, as valve pistons.

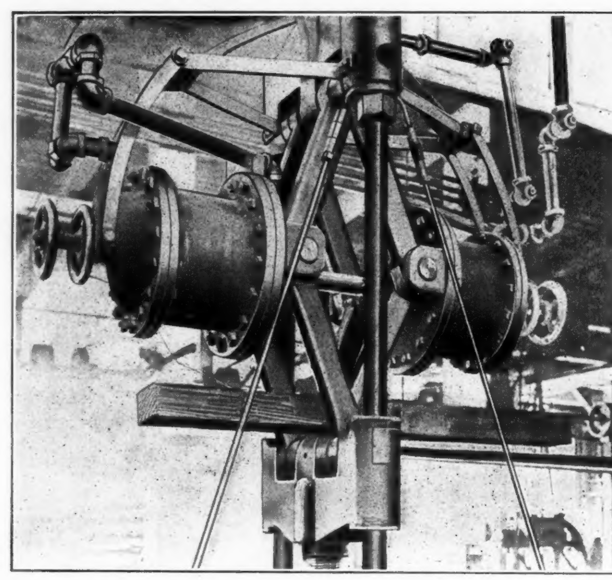


Fig. 2. Enlarged View of Head of Press.

The motor pistons are under the control of pilot valve *L*, the left-hand end of which regulates the supply of water to the cylinder and the right-hand end of which regulates the discharge. The upper valve *K* is a throttle valve, for the purpose of allowing the elevator to start rapidly, but compelling it to stop slowly. The sudden stopping of an elevator not only brings severe strains upon the mechanism, owing to the momentum of the parts, but also is extremely unpleasant for passengers because of the peculiar sensation that sudden stopping always produces. These objections do not hold to so great an extent, however, in starting an elevator, and it is desirable to bring it up to speed as rapidly as possible.

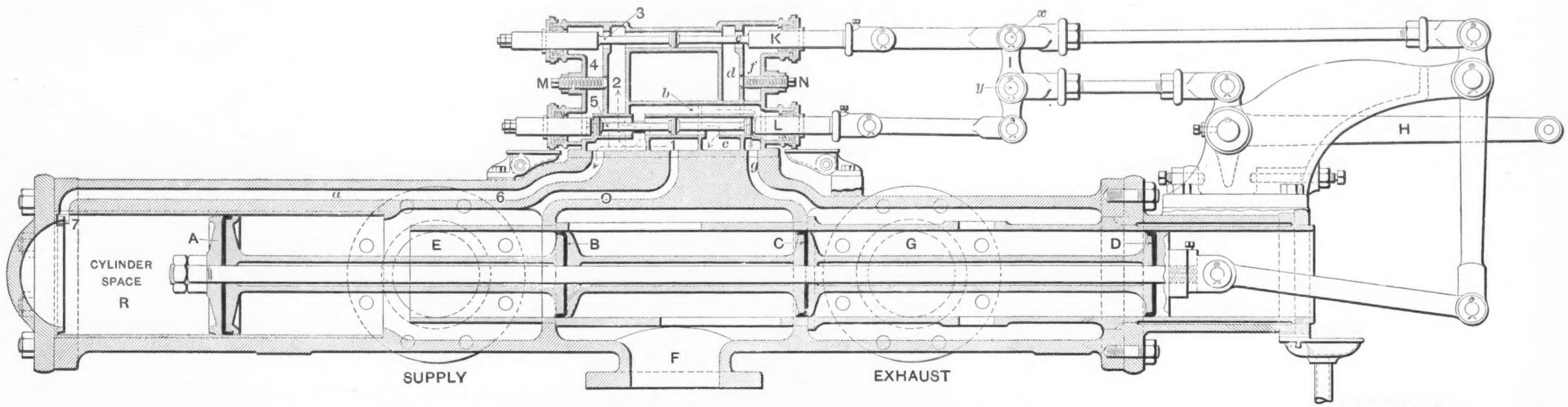



**Fig. 4. Three-way Valve for Elevator Control used by the Plunger Elevator Company.**

(1.) The action of the various parts of the mechanism of this valve can be readily followed out with the aid of the reference letters and figures of the engraving. The handle $H$ is under the control of the elevator boy, and is connected, by means of floating lever $I$, to the pilot valve $L$. The lever $H$ is shown in its mid-position, but suppose it to be raised, causing the floating lever $I$ to swing about point $x$ as a pivot and move the pilot valve $L$ to the left. The chamber marked 1, directly under this valve, always contains water under pressure, inasmuch as it is connected by the passage $O$ with the supply $E$. Chamber 1 also connects with chamber 2 by means of a cored passage, as indicated by the arrow. The flow of water is as follows:

From 1 to 2, through valve opening at 3; to chamber 4 through the valve opening at 5, owing to the pilot valve having moved to the left; thence through the cored passage 6 to the end 7 of the cylinder. This produces a balanced pressure on the motor piston $A$ and the water pressure between $A$ and $B$ acts upon $B$ and forces all the pistons to the right. Water can then enter the elevator cylinder from $E$, through the openings in the cylinder uncovered by piston $B$ to the port $F$.

It will be observed that the link connections are such that when these several pistons moved to the right throttle valve $K$ moved to the left while pilot valve $L$ moved back again to its middle position. When it reached middle position water was shut off from the cylinder, bringing the main piston to rest and allowing water to flow freely from the inlet $E$ to the port $F$, causing the elevator to ascend. The movement of throttle valve $K$ to the left, just referred to, closed the exhaust port $E$—the object of this being to compel the elevator to stop gradually when the handle is again moved to mid-position, as will shortly be evident.

(2.) Suppose lever $H$ to be now moved back again to middle position, for the purpose of stopping the elevator. Floating lever $I$ again pivots at $x$ and pilot valve $L$ is moved to the right. This allows the water in the cylinder at the left of piston $A$ to escape as follows: It flows through the passage $a$, around the valve stem of the pilot valve to $b$; thence through the port just opened by the right-hand movement of the pilot valve to the chamber $c$; thence by a cored passage to chamber $d$. At this point the water, in order to escape, must flow into the passage $f$, but as the port $e$ has been closed by valve $K$ the water must pass through an opening partially closed by the setscrew $N$, which thus checks the flow of water, and it finally escapes through the passage $g$ to the exhaust $G$. The water pressure at the left of $A$ being thus relieved, the pistons travel slowly to the left. By the time the pistons have reached mid-position, as in the drawing, water is shut off from the cylinder, the pilot valve $L$ is in mid-position, closing both the supply and discharge passages leading to the cylinder $R$, and the throttle valve $K$ is in mid-position, with the two ports which it controls wide open, to allow free passage of the water, and thus a quick starting of the elevator, no matter whether it is traveling up or down.

(3.) Finally, suppose lever $H$ to be moved downward. The pilot valve $L$ moves to the right, as in case 2 above, only it moves twice as far, because it is in a mid-position at the start instead of in its left position. Water again flows from the cylinder, following letters $a$, $b$, $c$, $d$, $e$, $f$, and $g$, the pistons move to the left, the elevator cylinder is placed in communication with the discharge opening $G$, and the elevator descends.

The travel of the pistons, however, causes the auxiliary valves $K$ and $L$ to move as before until the exhaust passage from the cylinder is closed and the pistons come to rest with the elevator still moving downward until lever $H$ is again brought to mid-position.

It will be seen from the above illustrations that whenever pilot valve $L$ is displaced there is a corresponding movement of the pistons, the extent of this movement being determined by the distance and the direction in which the pilot valve has been moved, and that when the pistons come to the corresponding position their motion will have closed the ports controlled by the pilot valve, and the pistons will stop moving.

* * *

Hon. Wm. R. Grace, whose death occurred recently, had been president of the Ingersoll-Sergeant Drill Co. for fifteen years. At a meeting of the board of directors of the company, the board adopted a resolution whose purport was to express their sorrow at the loss of their president and friend and to extend to his widow and family their deep sympathy.

## IMPROVEMENTS AT THE FORE RIVER SHIP & ENGINE COMPANY'S PLANT.

E. L. C.

In a former issue of MACHINERY we gave a description of the new plant of the Fore River Ship & Engine Company, Quincy, Mass. Since that time there have been many improvements and the works have been greatly extended. The original plant as first equipped was thought at that time to be one of the most modern and complete in its appointments of any of its kind, but recent inspection shows that many new and original ideas have been worked out, and that the position of this company has steadily advanced with the progress of the times.

They have under construction at this time the battleships *New Jersey*, *Rhode Island* and *Vermont*, and the protected cruiser *Des Moines*, for the United States Government, a side-wheel passenger steamer for the Fall River Line of the New York, New Haven and Hartford Railroad, a freight steamer and four large car floats for the same company.

The schooner *Thos. W. Lawson*, which has caused a commotion in shipping circles, being the largest vessel of the fore-and-aft rig in the world, and the only one having seven masts, was successfully launched and completed at these works, and caused the owners to at once intrust them with the building of another of nearly equal dimensions, and which has recently been launched and christened the *Wm. L. Douglass* and is now nearing completion at their new fitting-out dock.

Of the many improvements made at the yard the crane structure over the building slips now occupied by the battleships *New Jersey* and *Rhode Island* can be considered as one of the most important. This structure is 560 feet long and 180 feet wide, and of ample height to carry all weights clear when the ships are ready for launching. It has four separate high-speed electric cranes, two over each ship. These cranes have a capacity of five tons each and any two can be used at the same time on a weight of ten tons, taking in any location on either ship. While these cranes are rated at five tons each, their capacity can be worked much higher with safety, and by referring to next page two of these cranes can be seen transferring the stern-post casting of the battleship *Rhode Island* over the ship to place at the stern. This casting is of steel and weighs fourteen tons.

Fig. 1. Gantry Crane placing Smoke Stack on Cruiser Des Moines. Built by Wellman Seaver Engineering Co, Cleveland, O. Capacity, 49 ft. out, 168,000 lbs; 83 ft. out 78,400 lbs.; at extreme end 22,400 lbs.

Another great improvement now nearing completion is the fitting out dock, which is about 1,200 feet long, giving ample room to accommodate several large ships. A gantry crane traveling the length of this dock has a capacity of 40 tons, a distance out of 80 feet and 15 tons at the extreme end of boom. Some idea of the scope can be seen by referring to Fig. 1, showing it in the act of placing one of the smoke-stacks of the cruiser *Des Moines* in position. With the aid of this crane the fitting out of all classes of ships is made an easy matter.

Besides these improvements there has been added to the machine shop an area equal to the original size, now making room to handle work of the largest size with ease. To the ship tool shop they have added an immense area and fully equipped it with tools of modern design, and each tool has been supplied with one of their new-design handling tables, which increases their output with much less cost for labor, and is shown in Fig. 4.

Other buildings for foundry, angle smith, galvanizing and other minor branches have been added, which has called for a much larger and more powerful power plant, and to this department an addition has been constructed and fitted with boilers, engines and a large-sized air compressor of 5,000 cubic feet of free air per minute.

Their storage yard, which is 150 feet wide by 1,200 feet long, is covered by an electric crane, and this yard is connected by tracks to the main line at East Braintree. Their own locomotives are used to haul material to the yard, where it is taken from the cars and carried to any point of storage by the above-mentioned crane. This crane is of ample capacity to handle all material which may arrive.

These, with many other minor improvements, have now placed the Fore River Ship & Engine Company in a position to handle a large amount of work in an easy and profitable manner, and in a short space of time no limit will be placed on the amount and size of the contract which this company can handle.

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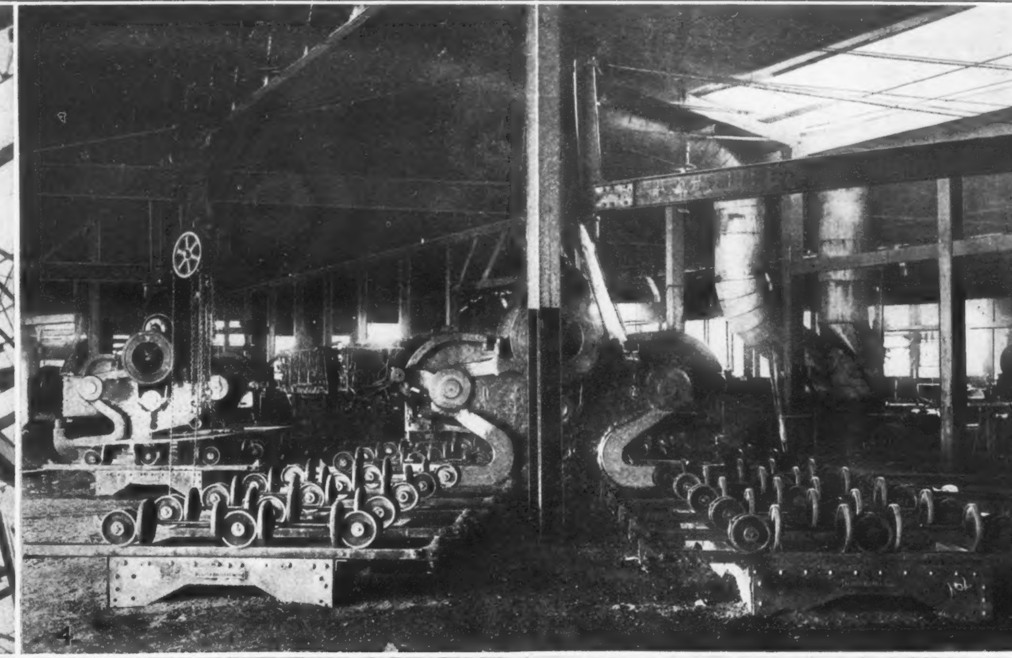
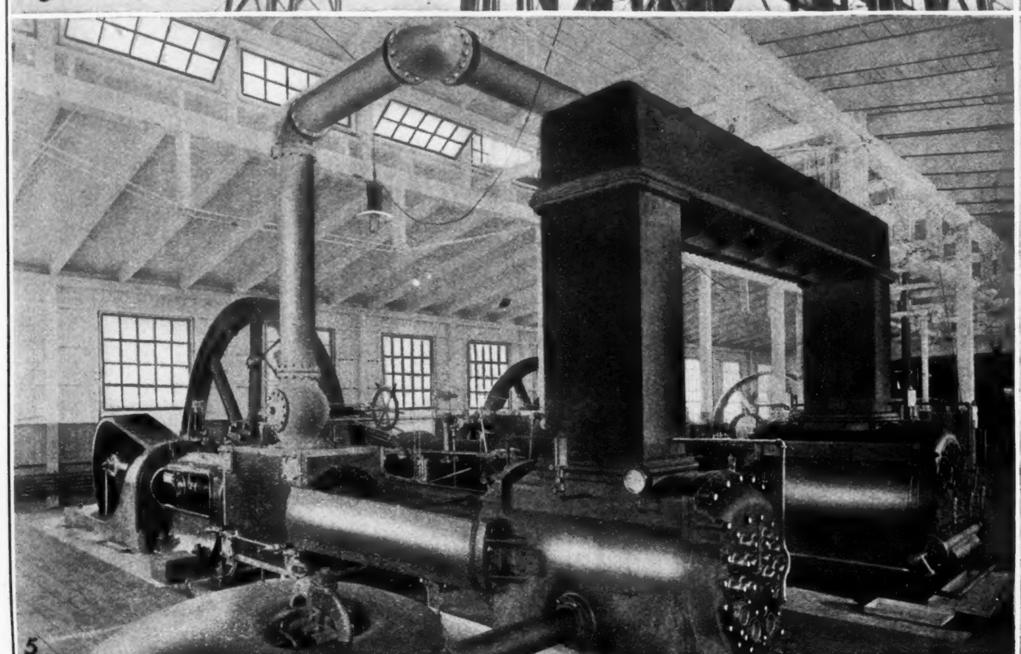
The yard and shops of the Fore River Ship & Engine Co. have been so much enlarged and so thoroughly equipped since the formation of the company a few years ago that the plant ranks as one of the four most important private shipbuilding plants in the east, and one of the largest in the country. In approaching the works the most conspicuous structure is the steel frame work that has been built over the ways, on which the largest ships are constructed. Unfortunately this is not so located that a photograph can be taken of it, and the view in Fig. 3 merely shows a section of the frame work



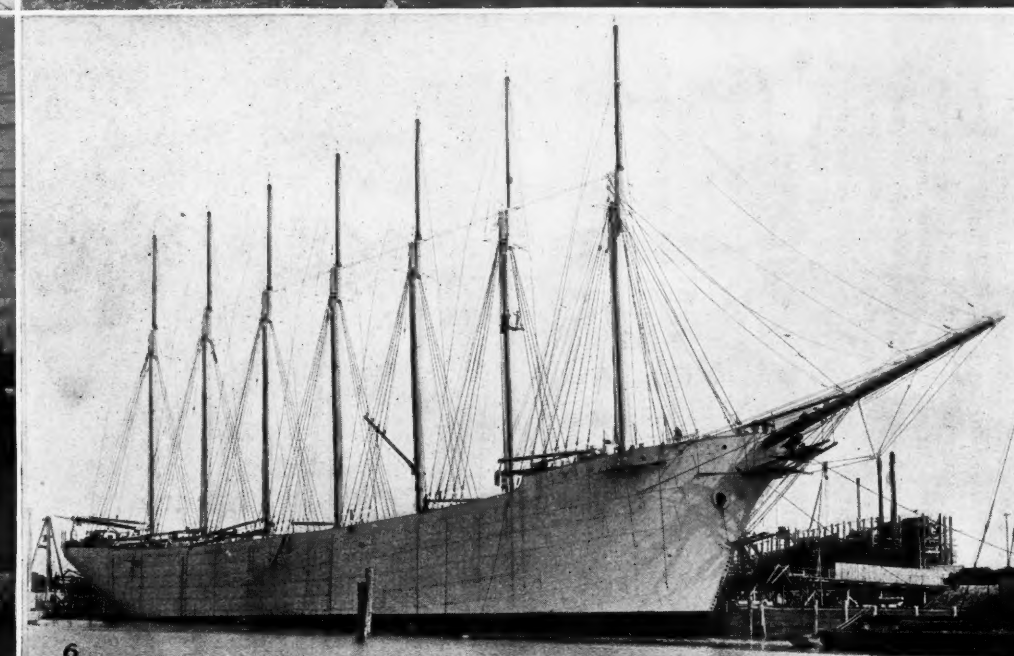




Fig. 3. Taking Stern post of Battleship Rhode Island over top of Ship to place, by two Electric Cranes in Crane Structure.

Fig. 5. Newly installed Air Compressor in Power House. Capacity, 5,000 ft. Free Air per min. Size of Steam Cylinders, 26 ins. and 48 ins. by 48 ins stroke. Size of Air Cylinders, 24 ins. and 40 ins. by 48 ins. stroke. Revolutions, 65 per minute, maximum

Fig. 4. Showing Improved Method of Handling Large Plates at Punches. Tables Invented and Patented by Fore River Ship & Engine Co.

Fig. 6. Seven-masted Schooner Thomas W. Lawson, built by Fore River Ship & Engine Co. Three hundred and forty feet long, 8,000 tons Capacity.

photographed with the camera pointing upward from underneath. The steam hammer in the forge shop shown in Fig. 2 is one of the heaviest tools in the place, and is employed in forging ingots up to 5 feet in diameter and some 12 or 15 feet long. The cylinder of the hammer is 40 inches diameter, 10 foot stroke, and the hammer itself weighs 17 tons. Steam follows throughout the stroke at 100 pounds pressure.

The equipment of the ship tool department is unusually complete; the punches, rolls, etc., being for heavy duty. One set of rolls is 35 feet long, and there are punches heavy enough to punch the openings in the floorplates used in the frame work for ships, at one operation. The yard where the structural material is handled is served by a crane traveling on raised tracks and having 160 feet span. In the previous

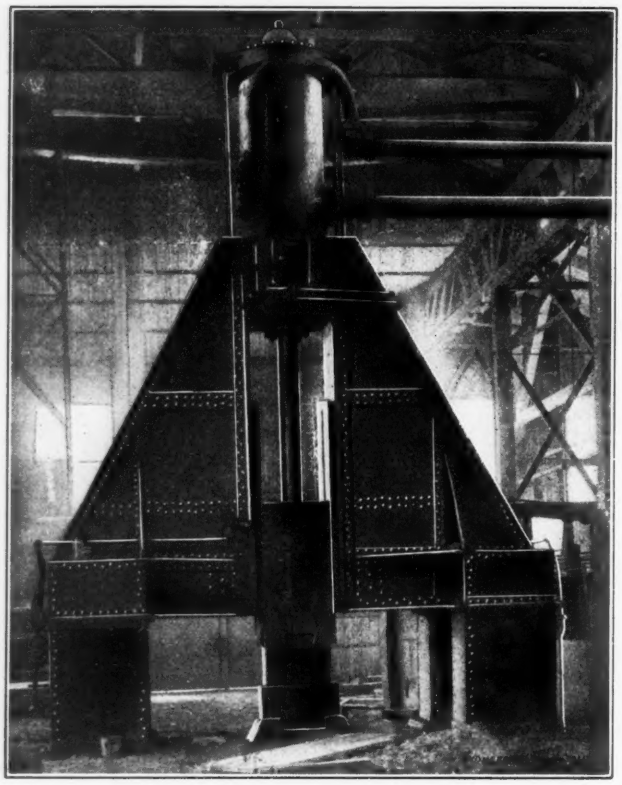


Fig. 2. Steam Hammer in Forge Shop. Cylinder 40 ins. by 1 ft. stroke, working under 110 lbs. Steam Pressure.

article on these works by our contributor information was given upon the equipment of the original machine shop, which has since been extended and there was also a description of the various buildings, including the large mould loft. In the shop equipment are several heavy lathes for turning and boring marine engine shafts, which we have previously illustrated and these, as well as the other tools about the whole plant, are driven by the Bullock multiple voltage system.

The plant is equipped for the building of a ship complete, including the hull, machinery, the forgings, boilers, and the cabinet work for the interior finish of the ship. In the latter department there is in use an ingenious machine for the production of wood beadings, moldings, etc., such as are used for the trim in the saloons, staterooms, etc., of a vessel. These are formed under pressure by rotary dies which are heated by electric current to the point where they will nearly but not quite char the wood. This machine is used under a royalty and the firm is not allowed to sell the products which it produces.—EDITOR.

* * *

A recent consular report refers to a German wood fireproofing process developed by Mr. Gautsch, of Munich, which is said to be very successful. The timber to be treated is placed in a vacuum, produced by pumping out the air. The cells are thereby freed of air and the wood is then impregnated under pressure with a solution of sulphate of ammonia and borax ammonia. The color, texture, or density of the wood is not affected thereby. The process renders it fireproof and proof against decay.

## EXTRAORDINARY SHAFT SINKING WITH THE JUMP DRILL OR TREPAN.

The use of the so-called jump drill is limited in the United States to the drilling of small bores for oil, salt, artesian wells, prospecting for minerals and similar purposes where a large diameter is not required, the diameter of the bores being rarely greater than 12 inches and usually less than 8 inches. But where mining operations are to be conducted, shafts must be sunk and this work is done by laborious process requiring much manual labor, even if assisted by power drills and good hoisting facilities. Shaft sinking by the ordinary means is at best difficult work, but when a shaft penetrates strata containing water in large quantities, it becomes still more difficult and often impossible because the flow of water is so great that it is out of the question to pump it as fast as it flows in. In general this limit is reached when the flow of water reaches 800 to 900 gallons of water per minute at an average depth of 150 to 180 feet. For this reason there are great coal measures in Great Britain, containing many thousand millions of tons of coal that have never been worked, that is, because of the impossibility of sinking shafts through the water-logged strata overlying them. The Kind-Chaudron process of shaft sinking, however, promises to make the working of such mines possible and probable, and partially for this reason, but more because of the novelty and magnitude of the apparatus, we present herewith an abstract of an interesting article on the subject that appeared in a recent issue of the *Colliery Guardian*.

The only practicable method for solid rock where the quantity of water exceeds that stated above, is the shaft-boring process invented by Mr. Kind. In the Kind process of shaft sinking the water is allowed to rise in the shaft to its natural level. The whole work of deepening the shaft proceeds under water by means of a boring apparatus suspended by rods, the whole work of sinking being managed from the surface. The

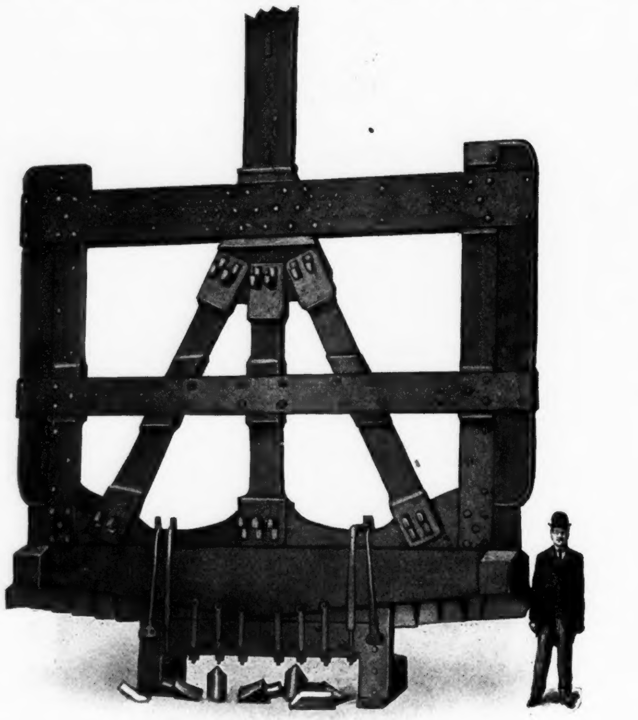


Fig. 1. Eighteen-foot Jump Drill or Borer, weighing 25 tons.

quantity of water, therefore, is quite immaterial, the shaft sinking progressing with the same speed whether the rocks to be pierced are water-bearing to an excessive degree, or whether they only carry small quantities. A pit is bored by means of a heavy borer called a trepan, which is the same diameter as the shaft to be bored. This borer is lifted to a certain height and then made to drop, crushing the rocks by knocking against the bottom of the shaft.

The illustration, Fig. 1, shows the construction of such an instrument, weighing about 25 tons and boring a hole 18 feet diameter, which has been used for recently-bored shafts. The design of this trepan, introduced by the firm of Haniel & Lueg, at Dusseldorf, has proved everywhere a success, and has shown

a great resisting power even against the hardest rock. The working parts proper of the borer are the so-called teeth, which consist of best quality tool steel; the ironwork giving the necessary percussion weight. The illustration, Fig. 2, shows a borer weighing about 12 tons, made to the latest design of Haniel & Lueg's construction, of the usual diameter of 8¼ feet. This small borer working in advance of the large heavy borer is exclusively intended to deepen the so-called pre-shaft, which receives the debris formed during the boring with the main trepan, thus preventing the chief boring being impeded by the dust.

Fig. 3 shows the arrangement by means of which both the large and the small borers do their work. A wrought iron balance beam *m*, about 9 tons in weight, is connected at its aft end, by means of a chain similar to a Gall's chain, to a steam piston controlled by hand and moving in the so-called batting cylinder *l*. Another chain of the same kind as stated above joins the fore-end of the beam *m* to the wooden boring rods *f*, and by these to the borer at the bottom of the shaft. If by the movement of the controlling lever steam is admitted on the top of the steam piston in the cylinder *l*, the boring rods *f* with the borer are lifted by the beam; if steam now escapes, the borer drops back by its own dead weight to the bottom of the shaft, breaking up the rocks by the steel teeth. After every percussion the borer is turned through a small angle by means of the wooden lever *o* turned by four workmen, who stand on the boring platform, so that every blow of the borer will strike another part of the shaft bottom.

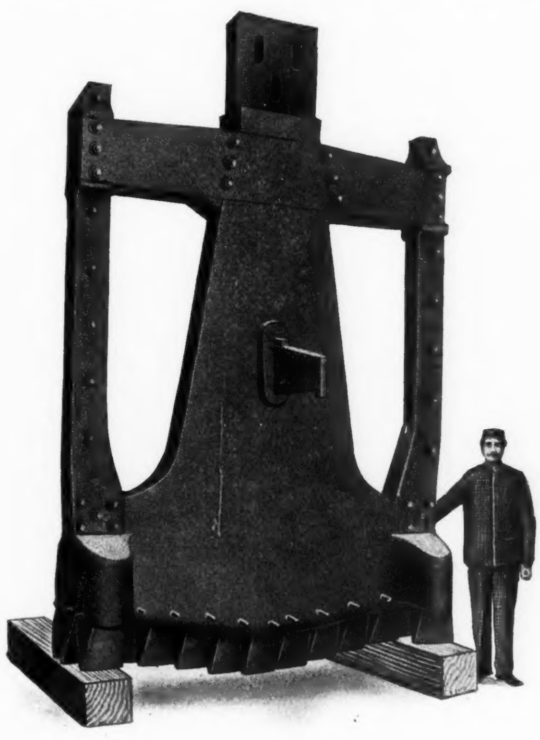


Fig. 2. Twelve-ton Borer.

The foregoing description will sufficiently prove the necessity of boring a pre-shaft. Working with the large borer only, so much debris would speedily accumulate in the bottom of the shaft that the effect of the blows would become almost inoperative. But the small borer having drilled at the middle of the bottom a kind of bowl to receive the rock crushings, these latter all fall down into the pre-shaft, thus preventing the chief borer from being impeded by the debris. The operation proceeds alternately in such a manner that the pre-shaft advances first for about 30 yards, the large borer following as far as possible. The debris amassed in the pre-shaft are brought to the surface by means of the mud-box *c*, Fig. 4, also called mud-spoon. This is a cylinder of about 6 feet diameter and about 1,350 gallons capacity, which is let down the shaft by means of the haulage rope. This mud-box being tossed repeatedly up and down, the muddy drillings will enter the box through the two bottom flaps, and the winding engine brings the filled mud-spoon to bank. Three boxes of mud per hour can be raised from a depth of about 180 yards.

Fig. 4 illustrates the wooden boring rods *f* as well as the adjusting screw *n*, the latter being used for lengthening the boring rods corresponding to the advancing depth. One rotation of the adjusting screw *n* corresponds to an elongation of the boring rods by ½ inch. Every time the adjusting screw has finished, it is screwed up again and a suitable lengthening piece is inserted.

It must be understood that the borer is not suspended from absolutely stiff rods, but at the top of the borer there are arranged what are termed "sliding-scissors," and above them a joint piece is inserted, which intermediate pieces render harmless the inevitable transverse vibrations of the rods. The small borer with sliding-scissors is seen in Fig. 4 at *b*. At the same time these sliding-scissors (while the borer is falling down) make it possible for the rods to continue their own independent motion, and to move down by some inches after the borer has struck against the bottom of the shaft. This so-called play of the sliding-scissors can also be observed at the balancing beam *m*, and at the batting cylinder on the surface, and indicates all events and occurrences that happen at the bottom of the shaft during the boring process. Further, you may know by its gradual decrease the degree of progress of work.

The impetus moving the rods downward when the borer falls is reduced to nought by means of a dash-catcher erected on the surface, which the balancing beam bounds against, after the borer has struck the bottom, at the same time the scissors come into play. By this means the rods are also brought to rest.

The advance boring is made with the free-falling apparatus. The principle of the free falling depends on the borer being raised with a great swiftness by means of the balancing beam, but this motion upwards is suddenly stopped by an obstacle lying under the extreme end of the beam, towards which the latter rebounds. The upward motion of the borer, rods, etc., is interrupted by this sudden stoppage, too; but the movable parts of the free-falling apparatus, especially the wooden shield, do not participate in the sudden check of the whole, but continue the motion upwards by their inertia, when the borer, rods, etc., have already come to a standstill; hereby the two catching hooks are hooked off and the borer falls down absolutely free. In each case this manipulation is the work of a moment.

The free-falling apparatus constructed by the firm of Haniel & Lueg has been perfected to so high a degree, and the action of the catching and hooking-out mechanism is so exactly regulated, that it has been found possible, by way of trial, to perform forty-five strokes per minute with a borer weighing about five tons only. But on an average we can estimate about thirty strokes per minute with a borer of the latest construction weighing about twelve tons. With the 25-ton borer or trepan the number of strokes is about twelve to fifteen per minute, the reduction number being necessary to give the workmen time to turn it around.

Shaft boring through the water-bearing strata continues until the borer reaches a formation which is quite certain to carry no water. In boring coalpits in Germany generally the green sand lying under the white marl is chosen to shut out the water. In England generally the coal formation itself may be chosen to finish the shaft boring in the absence of certain impervious permian strata. If in this rock which is free from water the shaft is deepened by boring about 30 yards more, then the boring work proper is finished, and means have got to be taken to dam out the water from the watery strata passed through. For this purpose, Messrs Haniel & Lueg manufacture solid cast iron shaft rings, each made in one piece, and these rings when built up on one another form the so-called cuvelage. This cast iron cuvelage was invented by Mr. Chaudron. The outside diameter of these shaft rings is about one foot smaller than the diameter of the large borer, thus being one foot smaller than the bored shaft. The flanges of these undivided rings are machined with the greatest exactness, so that the cuvelage makes an absolutely tight dam at the joints.

The thickness of these cast iron rings depends on the depth they are intended to be sunk to, i. e., on the outside water pressure they have to withstand; thus the weights of the

single rings vary between 5 and 18 tons. Now, as about sixty or seventy rings are required for a depth of about a hundred yards, the total weight of the cuvelage ordinarily exceeds several millions of pounds. It is obvious that no rope, chain nor headgear would be capable of supporting such enormous weights; and, therefore, in order to enable the rings to be put in, it is arranged to do this by tightening the lowest but one ring provisionally, by means of a cast iron bottom of the strongest construction to keep out water from below. This bottom causes the column of the cuvelage rings to float in the water of the shaft.

On the surface more rings are now continually built to the top of the first floating shaft rings, and in order to make the whole sink further, after having screwed up another ring, so much ballast water is let into the floating cuvelage that the cuvelage already joined together sinks in each case until the top flange of the top ring stands some yards above the surface of the water. This process is continued until the lowest ring reaches the bottom of the shaft. Thus a cast iron cylinder stands in its entire length in the bored shaft. It has already been proved possible to sink down twenty-two rings in twenty-four hours, thus making watertight about 40 yards of the shaft in one day. The horizontal joints between the single rings are tightened by means of sheets of lead about ⅛ to 1-10 inch thick; these sheets are tightened to the utmost when the iron rings are bolted together.

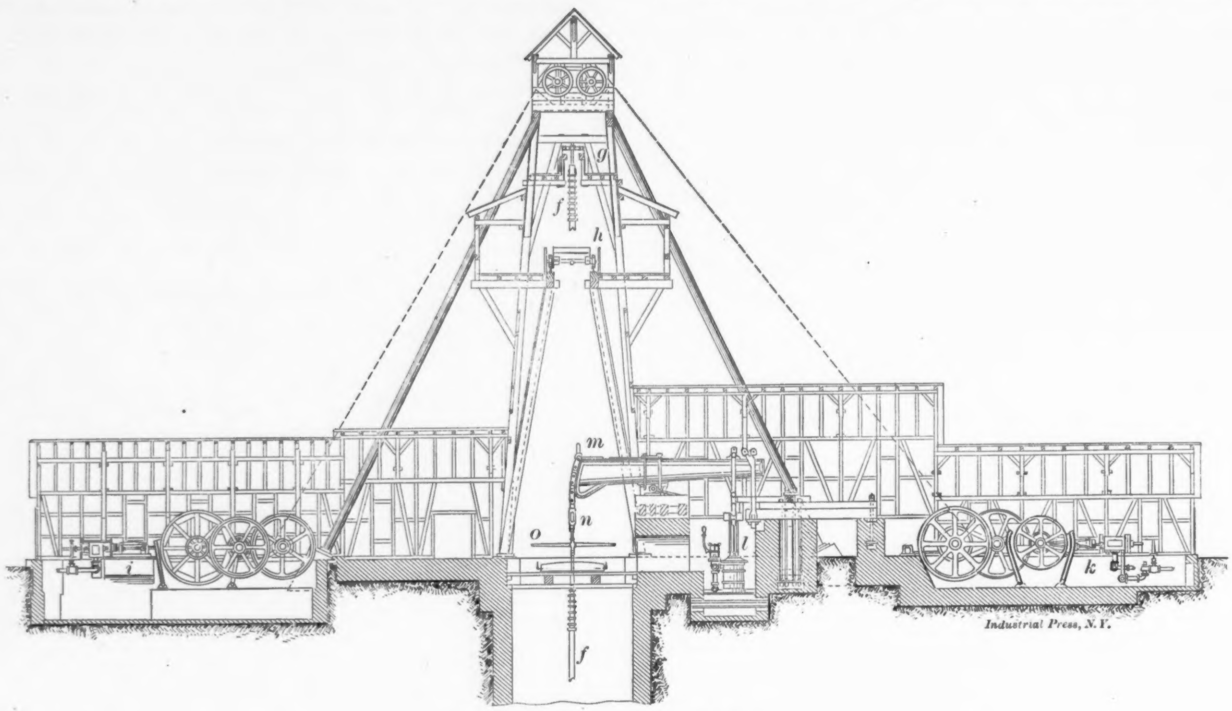



Fig. 3. Method of Actuating the Borer.

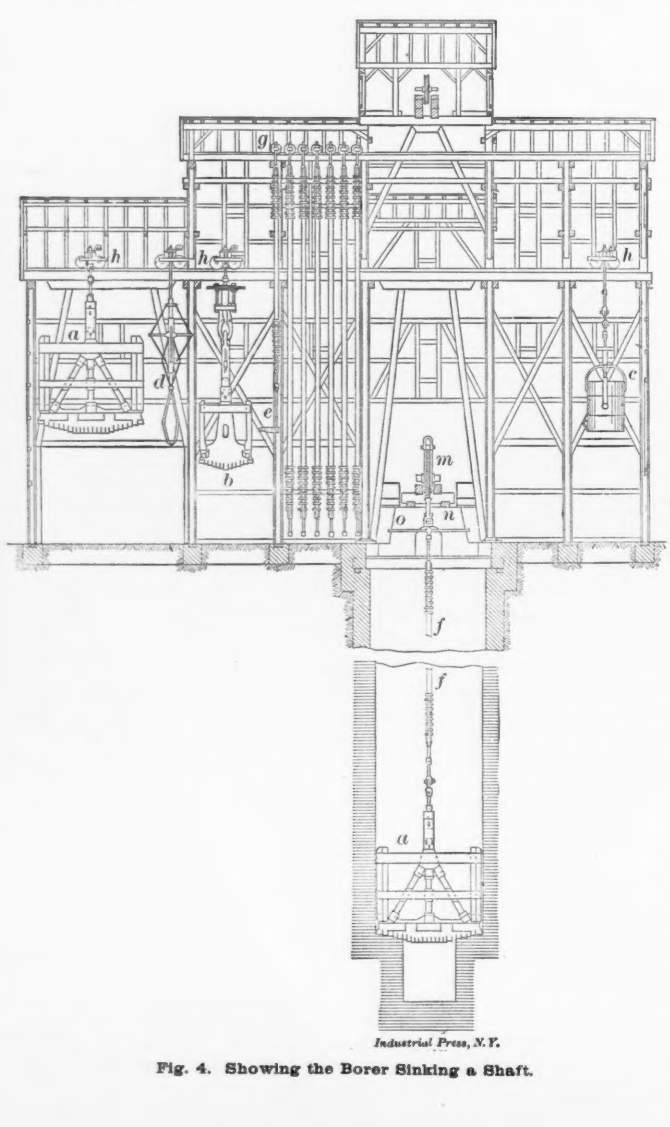



Fig. 4. Showing the Borer Sinking a Shaft.

The lowest ring is constructed in a different manner from the ordinary ones. It consists of two rings intended to telescope, thus forming a stuffing-box—the so-called moss-box. The packing material of this stuffing-box is moss or some other soft material rammed closely in the stretched moss-box and enclosed by a hemp net, so that the moss, etc., cannot tumble out of the box. When the moss-box, after the descent of all the rings, has reached the bottom of the shaft, more ballast water is pumped into the cuvelage, by which the box is telescoped, and consequently the moss comes under a strong pressure, so that the hemp net tears and the moss is driven out all round the rocky shaft walls. As the lowest part of the shaft, which the moss-box is to be set in, is supposed to be free from water, the moss compressed to the utmost between box and face of the shaft prevents any access of the water standing on the outside of the cuvelage to the bottom of the shaft. An outlet is given, however, to the water standing below the cast iron bottom of the cuvelage by a cast iron pipe rising in the center of the cuvelage to the surface, by which the water, having no outlet, escapes when the moss-box is driven together.

The water of the water-bearing overlying strata being cut off for the present, provision must be made for the final shutting out of this water by filling up with concrete the space between the outside of the cuvelage and the rocky shaft wall in its whole length. After the concrete is hardened, the ballast water is drawn out of the shaft, the cast iron bottom loosened and brought to the surface, and now it is possible to sink the shaft further in dry formations. A shaft 18 feet in diameter was sunk by this process near Hanover, Germany, 165 yards in one and one-half years, the net cost being about $180,000.

## ALTERNATING CURRENT CRANE MOTORS.

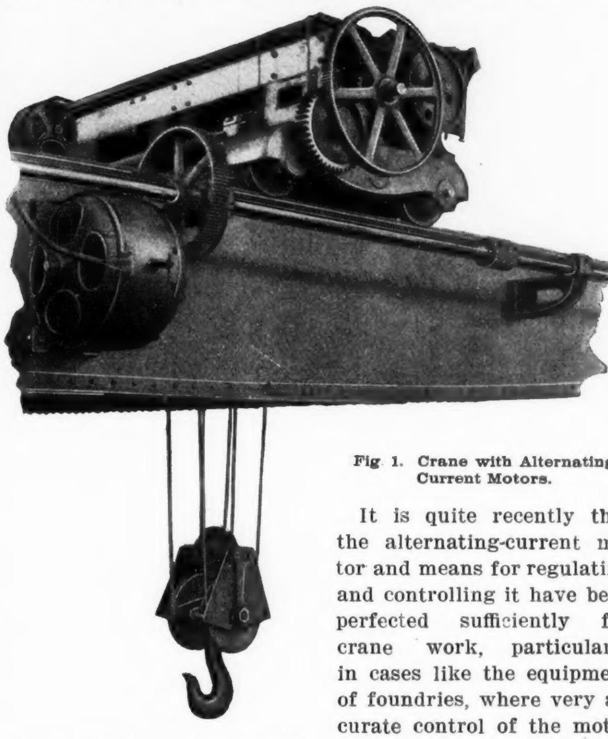


Fig. 1. Crane with Alternating Current Motors.

It is quite recently that the alternating-current motor and means for regulating and controlling it have been perfected sufficiently for crane work, particularly in cases like the equipment of foundries, where very accurate control of the motor is absolutely necessary to enable the handling of heavy molds, the withdrawal of patterns from the mold, etc. It cannot be doubted, however, that the alternating-current motor is making successful inroads upon the field of the direct-current motor, not only for driving machinery, but for crane service as well, and the advantage that it appears to have is in the direction of simplicity and durability under severe usage.

A plant is cited by the Westinghouse Electric Manufacturing Company that was equipped four years ago with forty of their crane induction motors, and which now has eighty of these motors. The cost of motor repairs has been only sixty dollars for the entire period, although the cranes are heavy and have been in constant and severe service.

The alternating-current crane equipment includes Type C variable-speed motors for the trolley, bridge, hoist and auxiliary hoist, two auto-transformers, one controller for each motor, and one electric brake for the hoist motor. The motor is without commutator, brushes or other moving contacts or wire, which parts are the most frequent causes of trouble in direct-current service. It will stand almost any amount of overloading without injury to its windings, and may also be reversed when running at full speed. In carrying material about a shop it sometimes happens that a crane must be quickly stopped to avoid a collision of its load with some unexpected obstacle. In such cases the bridge motor has been reversed at full voltage without damage, which indicates the amount of abuse this type of motor will stand in service. Variations in speed are secured by changing the voltage impressed on the motor, which is accomplished by two auto-transformers operated by a thirteen-point controller giving twelve speeds in approximately equal steps.

The auto-transformers perform the same service as the usual controller resistance—they cut down the line voltage to a value suitable for the speed requirements of the motor. There is, however, an important difference in the efficiency obtained by the resistance and the auto-transformer control methods. In the former a comparatively large amount of energy is wastefully dissipated in the resistance, whereas with the latter method only a trifling amount of energy attends the reduction of the voltage. An auto-transformer is a transformer having a single winding. It is connected across the line and delivers current at either of several different voltages, depending on which of the terminals distributed along its winding is connected to the motor.

Two auto-transformers supply all of the motors for a single crane. They are proportioned to meet the collective demand for current which may be made by the simultaneous action of all of the motors, but this circumstance is so infrequent in its occurrence that comparatively small auto-transformers suffice. The controllers designed for regulating and reversing these motors have a large number of steps for regulation, and are conveniently operated by a lever connected by a link to the controller arm. The controller is of the face type of construction, simple in design. The base is a slab of slate mounted on a cast-iron frame. Upon its surface are arranged contact segments of rectangular hard rolled copper bar. Each segment has two finished surfaces, and when one surface becomes damaged the segment may be reversed and the other surface used. The controller brushes are made of hard-rolled copper bar.

Fig. 2. Elevated Traveling Crane of the Gantry Type Operated by Alternating Current.

One of the novel features of an alternating-current crane is the use of alternating current for the brake magnets. The action of the alternating current magnet may be stated in general to be the same as that of an ordinary direct current solenoid magnet, but its construction is not to be as lightly approached. The peculiarities of the alternating current make the design of a successful magnet a difficult problem. The magnet consists of two U-shaped magnets having the limbs of their U's in a vertical position with coils surrounding each

limb. The upper U is fixed and supported by a bracket bolted to the motor. The lower U, which is known as the armature, moves upward when attracted by the fixed part, and falls when released, the movement being rigidly transmitted to the brake shoes by a bell-crank lever. When the magnet is energized, the armature is lifted, releasing the brake shoes; and

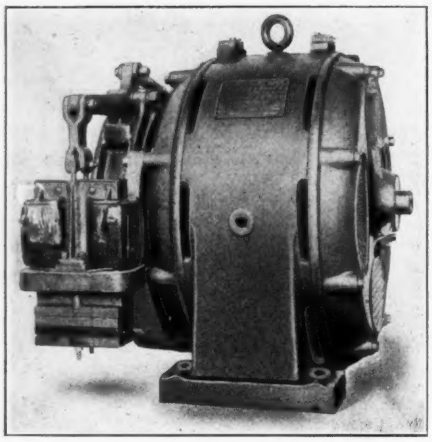


Fig. 3. Alternating Current Crane Motor with Alternating Current Magnet Brake.

when the circuit is opened, the armature falls, applying the brake shoes to the brake wheel. This automatic action is clearly apparent from the illustration.

The magnet itself is controlled by a small switch mounted upon the face of the controller. When the controller is moving off the first notch, the magnet switch is closed, and current

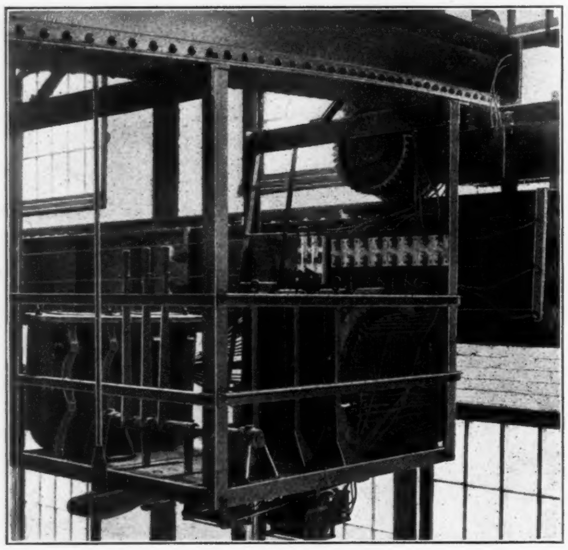


Fig. 4. Controller and Connections.

flows through the winding, energizing the magnet. When the controller moves to the off position the magnet switch opens and the armature falls by gravity, and should the power fail while the crane is hoisting, the brake would immediately set and prevent the load from falling.

* * *

A novel form of dam has been built in Germany over the River Main, which provides for the rapid discharge of floods, the whole upper part of the dam being raised bodily above the flood level. It consists of a hollow steel cylinder 115 feet long and 6½ feet diameter, having teeth or cogs on its periphery at each end. These teeth engage in racks, fixed in the masonry side walls, which are vertical at the lower ends but inclined to an angle of about 45 degrees at the upper ends. The rotation of the cylinder by suitable means, causes it to roll up the inclined racks to such a height as may be necessary to clear the water. The steel plates forming the cylinder are 1.1 inch thick and its total weight is 193,600 pounds. Electric power is used for raising and lowering, suitable reduction gearing being provided so that an 18 horse power motor can raise the dam to a height of 13 feet above the sill in about fifteen minutes.

## AN AIR LUBRICATED JOURNAL.

ARTHUR W. COLE.

When one considers the question of lubrication he naturally thinks of oils as the lubricating agent. This is without doubt because for many years oils have been the chief lubricant in use in the arts. The fact is, however, that there are other substances which occur in nature, that have been shown by experiment to be as good if not better than oil. The substances to which we refer are the air and the water.

During the last few years water has been used for the purpose of lubrication in the arts chiefly in the tailshaft bearing of ocean steamships. The construction of these bearings allows the water to circulate freely about the shaft, thus keeping the bearing flooded and affording good lubrication. Water is also circulated around the main bearings of the engine, where it aids the oil by conducting away the heat caused by the friction of the moving parts.

The lubricating possibilities of air, also, have long been recognized, as, for example, its action between two well-fitting surface plates, but it was not until some three or four years ago, when experiments were conducted at the Worcester Polytechnic Institute, that its possibilities in this direction were actually demonstrated in connection with cylindrical bearings.

The apparatus as mounted for the purpose of demonstrating this property of air is shown in Fig. 1, and also in Figs. 2 and 3. The essential parts are the cast-iron ring or sleeve *R*, and the steel plug or short piece of shaft *P*. The plug is six inches in diameter, six and one-quarter inches long, and its weight fifty and one-half pounds is the load on the bearing. The bore of the ring and the cylindrical surface of the plug are carefully finished by grinding so that they are very nearly true cylinders. The diameters of the two surfaces differ on the average by about .0016 inch. The sleeve is closed at one end. Two valves $V$ and $V^1$ are provided; one of which is opened to permit the escape of air while the plug is being inserted. When in place, the plug is about ¾ of an inch from the head; then, the valves being closed, the end motion of the plug is limited by the confined air. The plug is set in rotation by means of the wooden handle *H*. Higher speeds are obtained by an ordinary geared hand drill, shown at the right in Fig. 1, the slot in the iron plate in the end of the handle *H* being adapted to fit the hand drill.

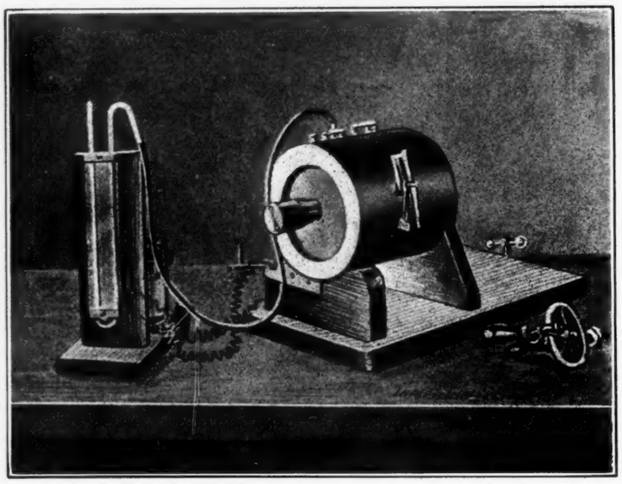


Fig. 1. Apparatus for Testing Journal

The ring *R* is mounted on a wooden frame as shown so that it may be turned about its axis, bringing any one of the test holes which are numbered from 1-6 into any desired position. The setting is made by the graduations on the face of the ring.

The auxiliary apparatus shown at the left of Fig. 1 consists of a mercurial manometer which may be connected with any one of the test holes by a rubber tube and nipple; also a galvanic cell with a bell in circuit, one terminal being in contact with the ring at *S*, Fig. 2, while the other terminal may be brought into contact with the plug at *T*.

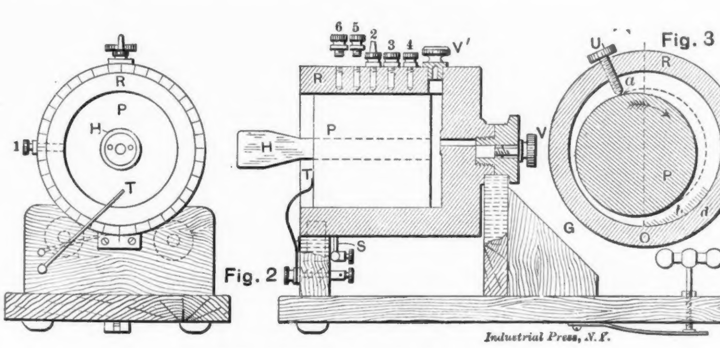
When the plug *P* is at rest its weight is supported by

metallic contact between the plug and the ring. This fact is evidenced by a grating sound if the plug is turned very slowly from its position of rest, and also by the ringing of the electric bell if the wire $T'$ is placed against the plug. However, if the plug is revolved more rapidly, an entire change of conditions ensues; the grating sound is no longer heard, and if the wire be placed against the plug the bell does not ring as before. This fact is positive proof of the existence of the film of air about the revolving plug, as is the case when perfect lubrication exists with other fluid lubricants, by virtue of the viscosity of the lubricating fluids and the adhesion of the surfaces of the bearing.

The small difference in diameter of the bore and the plug as above explained is essential to the formation of the film and the separation of the surfaces. Still this film when formed is not of the same thickness at all parts, that is, the plug is not in the center of the hole. This is shown by inserting a small screw through the hole marked No. 1, as shown at $U$, Fig. 3. While the plug is revolving, the screw is turned until it touches the plug, as shown at $a$, the contact being determined by the ringing of the electric bell. If without further adjustment of the screw, the ring is turned slowly to the right, the contact is lost but is found again when the screw comes into position of $b$. Should the ring be turned in the opposite direction, the contact increases, as shown by the increased energy in the ringing of the bell. This shows that the plug is not revolving in the center of the bore and that the surfaces are nearest together at a point $G$, found by bisecting the arc $a\,b$. This may be verified by placing the screw in contact with $G$ and turning the ring both to the right and the left from this position. In either case the contact will be at once broken.

The position which the point $G$ takes on the circumference of the bore varies with the speed of rotation, that is, the axis of the plug and bore tend to approach each other as the speed increases.

The position which the plug takes within the bore implies that there is an unequal distribution of pressure in the air film. In order to determine this distribution of the pressure in the lubricating film of air, a nipple is screwed into one of the test holes; from it a small rubber tube leads to the mercurial manometer described above. By turning the ring to bring the hole into any desired position, the pressure may be noted at any point about the bearing. In this manner it is found that there is a negative pressure at the top of the bearing and a positive one at the bottom. By this we mean that the pressure at the top was found to be less than that of the atmosphere and at the bottom, greater. It was observed in this experiment that the decrease of pressure at the top of the plug is nearly equal to the increase at the bottom.




Figs. 2 and 3. Details of Apparatus.

From experiments with the air-lubricated journal, it must be concluded that the lubricating agent in all journals where perfect lubrication exists is distributed in a similar manner to the air film in the above tests.

The existence of a positive and negative pressure in the film shows us at once the place in which the lubricant should be admitted to the bearing. If in the above case, a hole should be made at the point of greatest positive pressure, it is obvious that the air would flow in at the first opening and out at the second. Therefore, if a lubricant is to be fed automatically into a journal the opening for inserting it should be made at the point where the pressure at the most is no greater than the atmosphere and no openings should be made where the pressure is above the atmosphere. These conditions are easily fulfilled in a bearing in which the pressure is always in the same direction; changes in the direction of the pressure will, however, greatly complicate the problem.

* * *

## PREMIUM SYSTEM IN ROYAL NAVY SHOPS.

On the 14th of March the British Admiralty adopted the premium system for the shops connected with the various dock yards, and the accompanying notice, reproduced from

# NOTICE TO WORKMEN.

On March 14th, 1904, the Premium System of Payment for labour will be introduced in this shop. At first it will be applied to certain classes of machine work, and if satisfactory results are obtained, the system may be extended.

The system will enable workmen to earn, in addition to their ordinary weekly wages, extra remuneration for doing work in less time than the fixed time allowed for it.

The system may be briefly described as follows:—

When a piece of work is given out, a certain time, based on known times taken for similar work done on ordinary time in this shop, will be allowed for it.

This time allowance will include all the necessary time for obtaining tools and materials, preparing the machine and lifting and setting the work in or on the machine, any removal and resetting, change of tools, and removing work after completion.

If the work is satisfactorily completed in less time than the fixed time allowed for it, the workman becomes entitled to a premium varying in amount with the time saved.

If on the other hand he takes longer than the time allowed, he will still be paid his ordinary wages.

From this it will be seen that while the workman may increase his wages by his own individual effort, he cannot lose money by the introduction of the system.

Premium will be calculated as follows:—

The value of a "premium hour" will be considered to be 1/48th of the workman's weekly wages, and the amount of premium earned on a job will bear approximately the same relation to the ordinary wages due for the time taken to complete it, as the time saved bears to the time allowed.

To give an example:—

Suppose a man is given 48 hours to do a job and does it in 36 hours, he saves 1/4th or 25 per cent. of the time allowed, and accordingly will be credited with 25 per cent. of the time taken to do the job, which is 9 premium hours, so that

A mechanic in receipt of 36s. per week, and whose "premium hour rate" would therefore be 9d., would receive 9 × 9d. = 6s. 9d. premium for this job in addition to his ordinary wages for the period worked.

Similarly:—

A skilled labourer in receipt of 24s. per week, and whose "premium hour rate" would therefore be 6d., would in the example quoted above receive 9 × 6d. = 4s. 6d. premium.

A convenient way for the workman to calculate his premium is to multiply the time taken by the time saved, and divide the product by the time allowed, all times being taken in hours. This will give the premium in hours which, multiplied by the "premium hour rate," will give the amount of premium earned.

Or it may be stated thus:—

$$\frac{\text{Time taken} \times \text{time saved}}{\text{Time allowed}} = \text{Premium time.}$$

Taking the case already given:—

$$\frac{36 \times 12}{48} = 9 \text{ Premium hours.}$$

The time taken will be recorded to the nearest quarter of an hour.

In calculating the premium the time taken will include all the working hours from the time of commencement of a job up to the time of commencing the next job.

Overtime, and night and day shifts, will be paid for at overtime rates as at present, but will only count as ordinary hours in the calculation of the "premium."

Lost time, or absence without leave, will count in the time taken. Absence with leave will not be included in the time taken.

The working of the system will be as follows:—

Each workman on commencing a "premium" job will receive a "Job ticket," on which he will find a description of the work to be taken in hand, the date and time of commencement of the job, the time allowed for it, and other particulars as to ship or service, head of charge, &c.

On this ticket the Shop Measurer will fill in the daily time worked, and particulars of overtime, leave, and lost time, and when the job is finished the time of completion will be inserted on it to the nearest quarter of an hour.

The ticket is then to be returned to the Inspector, and if the man's next job is also to be executed on "premium," the time of commencing the new job will be the same as that of finishing the previous job.

As soon as possible after a job has been inspected and passed as satisfactory, the amount of premium earned on it will be communicated to the workman.

Premiums will be paid weekly on the Friday following the week in which they have been earned.

It is to be clearly understood that a "premium" is not earned until the finished work has been inspected and passed as satisfactory.

If a man's work when finished does not pass inspection he will receive no premium for that job unless he can make good the work in the time allowed, in which case he will receive the premium on any saving of time still remaining.

No premium will be paid on articles that turn out defective, on account of faulty material or other causes, during machining or other operations; but if one or more of several similar articles, for which a covering time allowance for the whole is given, should turn out defective, the workman will still receive any premium earned on the rest of the articles, the premium being calculated on the saving of time made on the reduced time allowance corresponding in proportion to the number of articles satisfactorily finished.

No allowance will be made in the time taken for stoppages occasioned by breaking of straps, stopping of driving machinery, or any other cause.

In cases where a job is stopped in order to undertake more pressing work, or for any other purpose, the workman will return his "job ticket" to his Inspector, and the date and time of return will be noted on it (this being the commencing time of his next job if a "premium" job). The time spent on the job up to the time of interruption will be counted as part of the time taken, and on reissuing the ticket, the time allowance will, if necessary, be so revised as to give the workman as fair an opportunity of earning "premium" on the whole job as would have been possible had the work not been interrupted.

As far as practicable, time allowances for definite operations will not be reduced after they have been once satisfactorily established and regarded as standards, unless a new method of manufacture necessitating a revision of the time allowance be introduced. But if an established or standard time is seen to be operating unfairly to the workman, it may be increased with the sanction of the Principal Officer of the Department.

As some of the work in the Department may not be deemed suitable to be done on "Premium," it is to be understood that a man may be required to work on "premium" or on ordinary weekly time rate as occasion and the work may require.

Apprentices will not for the present be employed on "premium" work.

It is hoped that the introduction of the Premium System will lead to the workmen taking an increased interest in their work, machines, tools, and equipment generally, and to keenness on their part in pointing out to their Officers where improvements may be made and time saved, resulting in better methods of work.

It is pointed out that increased energy and industry on the part of the workmen added to such improvements as may be adopted from their suggestions and resulting in work being done in less time than hitherto, will immediately benefit them by increasing their "premium" earnings.

*By Command of their Lordships,*

Evan Macgregor.

the poster announcing the introduction of the system, contains particulars that will be of interest to many readers. The poster was first reproduced in *Page's Magazine* (English), from which we have made our illustration. Those interested in shop systems can get out their reading glasses and see what "His Majesty's" ideas of profit sharing are.

* * *

What any particular service is worth in cold cash depends on the exigencies of the case and largely upon the position of the creditor to enforce his demand. Not everyone, however, is as favorably situated in both particulars as a Connecticut motorman is reported to have been recently. It seems that he is something of an expert in opening safes that baffle their owners and that he had been employed by a Torrington firm to open a safe which contained all their money and books. After a few minutes *skillful* work the safe door swung open, whereupon the motorman expert demanded $5 for the job, which was refused on the ground of being too much. He immediately closed the safe door, locked it and walked away, leaving the owners "in the hole," or rather outside the safe, and according to last accounts they are still there. Probably an expert from the safe factory would have presented a bill for a day's time and traveling expenses.

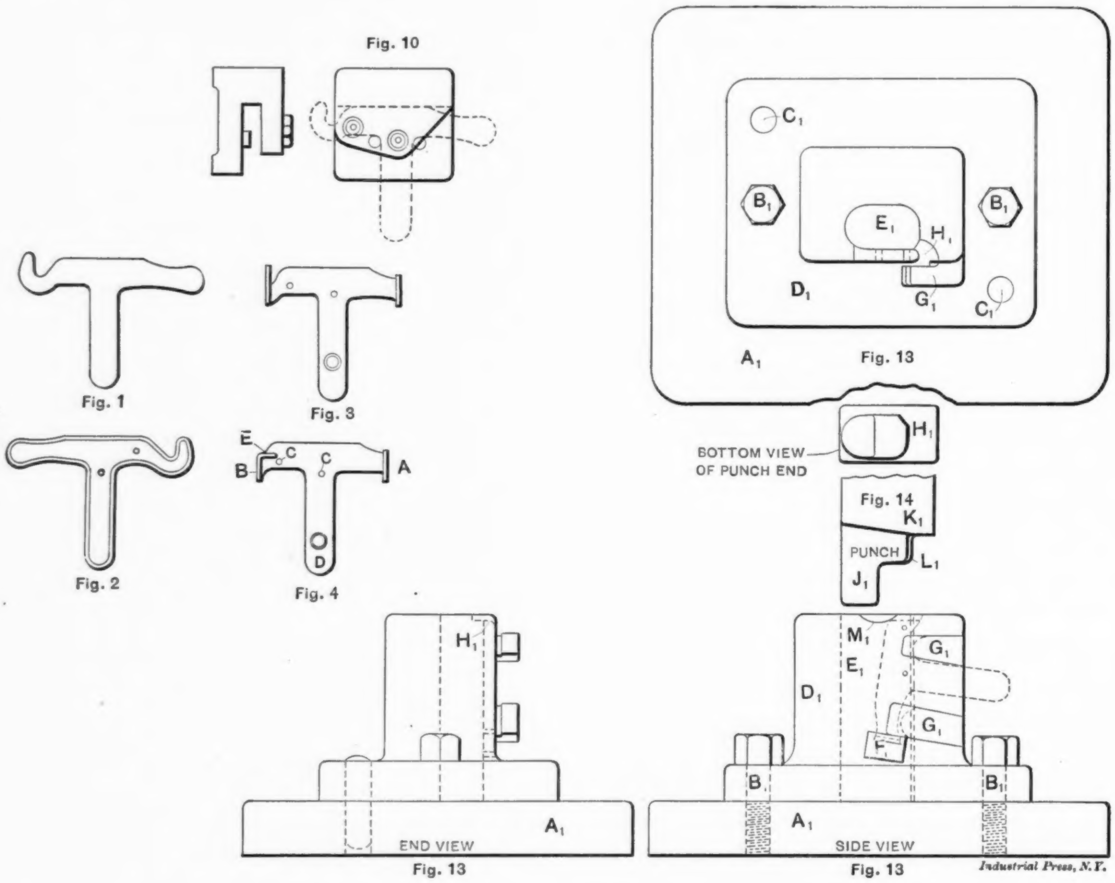
# THE MAKING OF A SHUTTLE CARRIER.

## A LITTLE INFORMATION UPON SEWING MACHINE WORK.

H. ROBINSON.

The method employed in the making of shuttle carriers for sewing machines varies considerably, as in the making of other parts. It is governed and depends on the following conditions: 1. The shape of the shuttle carrier, which varies, more or less, with every different type or make of sewing machine; 2. The quantity to be made, consequently the justifiable sum to be expended on tools, as well as their durability; 3. The machinery in the factory, where the tools are to be made, must be worked in; 4. Toolroom facilities where the tools are to be made; 5, The amount of time the "management" department allows for designing, making of the drawings, and building them; and finally, 6. The intelligence, or the lack of it, as well as the prejudices of the factory help, who are to handle them, as well as their "boss," who always knows or thinks he knows, more than the "collar-and-cuff" dude in the drawing office.

to the depth of about 3/8 inch to insure the die keeping its size, approximately after repeated grinding, while the rest of the depth of the opening is tapered considerably more, to facilitate the egress of the punchings from the die. The stripper $H$ is planed out at the bottom to act as a guide $K$ for the steel to be punched, and the top port heavy enough to strip the waste from the punch without bending. It is fastened to the die block with screws and dowels $E$ $F$, only on one side, the other side being left open to facilitate its operation. The gage pin $G$ is sufficiently removed from the extreme cutting edge, to permit the arrangement of the punching, as shown in Fig. 7, which is done by punching one row first, then turning the strip over, and punching the other row between. The punch, $M$, Fig. 6, is milled out from a solid block of steel, the size of the flange. This is better practice than planing the punch across and fitting it in a flange and riveting it slightly on the block, through a mistaken notion of economy in the making, which may be true where there is a want of tool room facilities, but where a milling machine is within reach, the practice of making this class of punches




In the accompanying illustrations, Figs. 1 to 4 inclusive are intended to show the method employed in the making of a shuttle carrier for a certain type of sewing machine newly put on the market under a "you-can't-get-it-out-too-quick-or-too-cheap" condition, and for an unknown quantity. A finished shuttle-carrier is shown in Fig. 4. It is made of cold rolled steel 1-16 inch thick, the outer edge is rounded, the end $A$ is bent at right angles, while the opposite end, $B$, has a double bend in it as shown. It also has two small holes $C$ $C$ for riveting on a flat spring and one tapped hole $D$ for the connection with the shuttle-carrier lever. With the tools here described it takes six machine operations to bring it into that shape.

The first operation is cutting out the body, as shown in Fig. 1, and is done in a stamping press, with a punch and die, as shown in illustrations, Figs. 5 and 6, which blanks the bodies of the carriers out of a strip of cold rolled steel. This, of course, is done in a way to insure the greatest economy in the material, as in Fig. 7, which shows a piece of strip of the steel after the blanks have been punched from it. The body of the die $L$, Fig. 5, is a block of tool steel of sufficient thickness to prevent its springing while in operation. The cutting sides of the opening $J$ taper inwardly about 0.001 inch

solid or of one piece with the flange is the cheapest, as well as the best in every way in the long run. The punch is fastened to the holder $O$ with screws and dowels $P$ $Q$.

The next operation is the rounding of the corners on the outer side of the shuttle-carrier, as shown in Fig. 2, and is also done in a stamping press with the kind of punch and die shown in Figs. 8 and 9. The operation may be best designated as a squeezing, or squashing, operation; the bottom port, or the die, Fig. 8, is a tool-steel block hardened and ground straight and smooth on the surface. It is fastened with screws $U$ to the holder, or shoe $S$. The shuttle-carrier blank, of the form shown in Fig. 1, is laid on the surface of the block $R$, between the spring gage pins $T$. The punch, Fig. 9, is of hardened tool steel, and has an impression $W$ in its face $V$, the same form as the blank, Fig. 2; its depth is equal to the thickness of the blank when the punch fastened in the ram of the press comes down on the blank. Lying on the surface of the die it presses the gage pins inwardly, out of the way, and the round corners $c$ in the depression in the face of the punch, strike, squeeze and round over the sharp corners of the blank, making it in the form of Fig. 2. The blanks are then "tumbled" for some time, to remove all sharp

edges and to brighten them up. When taken out the two rivet holes *C C*, Fig. 4, are drilled in a jig, Fig. 10, and the hole *D* is punched in a small punching die, and tapped.

The two ends of the blank *A B* are then bent over in the bending punch and die, Figs. 11 and 12. It will be noted that the side of the bending block *X*, Fig. 11, is slightly tapering inwardly, in order that the end of the blank bent over that side may, when taken out, remain at right angles, which would not be the case if the side of the block was made

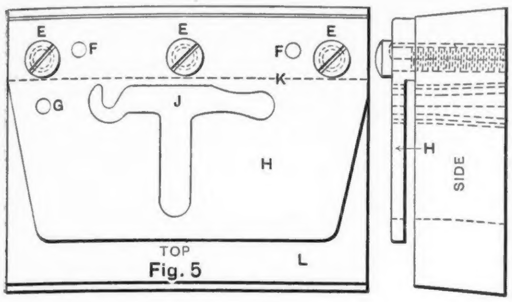


Fig. 5

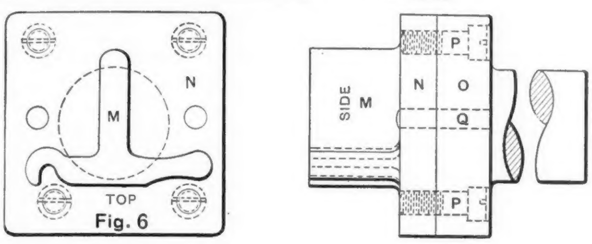


Fig. 6

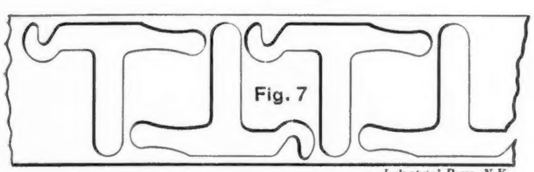


Fig. 7

*Industrial Press, N.Y.*

square, as the material bent always springs back more or less. The block *W* is of tool steel, hardened and fastened with screw *Z* in the shoe *Y*. The faces *a* of the bending punch, Fig. 12, are hardened and ground out to the thickness of the bending block, plus two thicknesses of the metal of the blank; its operation is obvious from the illustrations. After the blank is operated on in this tool, it is of the form shown in Fig. 3.

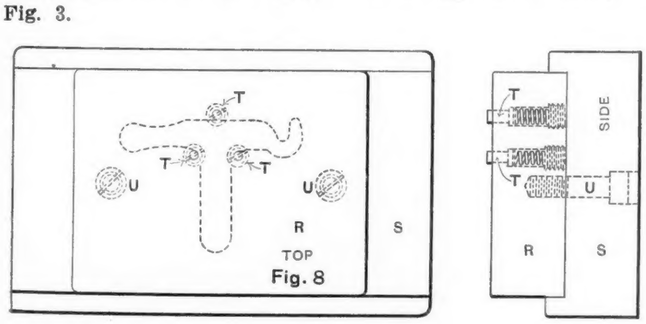


Fig. 8

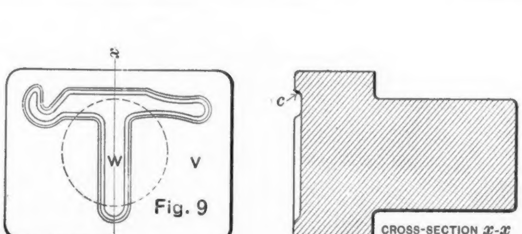


Fig. 9

CROSS-SECTION $x$-$x$

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We now come to the last operation on the blank, that of forming the second bend on the side *B* of the point *E*, as shown in Fig. 4, which has to be brought to an exact position, without in doing so distorting the shape and form of the rest of the body. And while it is done in an ordinary stamping press, having the requisite stroke, the forming tools, which are in the form of a punch and die, are of a peculiar design and make, as will be noted from illustrations, Figs. 13 and 14. Like a good many other tools that, when made, are of simple manipulation, it may not impress the superficial observer. The difficulty is the original conception and determination of its shape and form, to meet in an inexpensive and simple manner the requirements for the successful performing of its operations. In Fig. 13, the base plate $A_1$ is cast iron. Fastened to it with the screws and dowels $B_1$ $C_1$ is a tool steel block $D_1$, through which there is a perpendicular hole $E_1$; on the side near the bottom there is a square hole $F_1$ leading into the opening $E_1$; two "jaws," or lugs, $G_1$; a depression $H_1$ and cut out port $M_1$ on the top. The shuttle-carrier as shown, with dot and dash lines, lies up against the side of the block, its bent end *B* fitting in the depression $H_1$, with

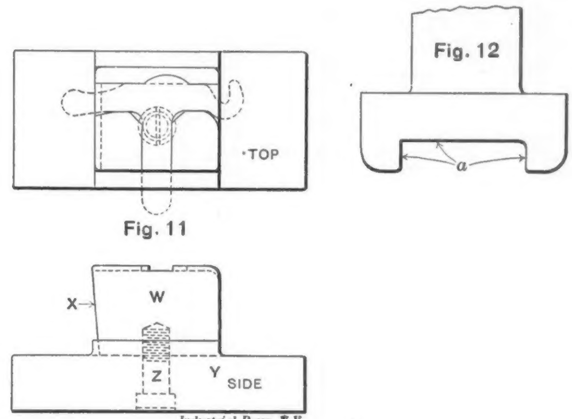

Fig. 12

Fig. 11

*Industrial Press, N.Y.*

its point *E* overhanging in the opening $E_1$, while its other end *A* as in the opening $F_1$. The two jaws $G_1$ keep it from "tipping" when the point $E_1$ is getting bent by the punch, Fig. 14, which, it will be noted, has a longer end $J_1$ on one side, that enters the opening $E_1$, first, and when the punch port $L_1$ comes up against the point of the carrier *E* and bends it, it keeps it from getting away. The part of the punch marked $K_1$ flattens and sets the side of the carrier, after the point *E* is bent over; when that is done the punch goes up. To take the completed shuttle-carrier out, it is necessary to raise it up slightly to move it forward out of the jaws $G_1$ when the top of the carrier gets in the middle of the recess $M_1$, it is taken out completed, as shown in Fig. 4.

* * *

## OUR BATTLESHIPS.

A rather startling statement was made in Congress by Senator Hale, of Maine, in discussing the naval appropriation bill, that the battleships Indiana, Massachusetts, Oregon and Texas should not be counted as ships of the main line of defence after the year 1908. This means, of course, that they will be looked upon as practically obsolete by that time. This raises the question as to the active life of our modern $5,000,000 and $8,000,000 battleships. Judging by the Oregon, which most people believe to be a crack ship of the navy even now, a battleship will become obsolete within twelve years. The reason for such a condition has been mainly because of the contest between armor and armament, resulting in the rapid and very great improvement of each, so that a ship of ten or twelve years ago would stand no chance against one equipped as a vessel would be fitted out to-day. The next step, however (which may result in all the battleships of the present era becoming obsolete) will undoubtedly be the substitution of high-power turbines for the more cumbersome reciprocating marine engines, in which case the battleships of the future would be able to steam over a much greater radius and, in cases of emergency, at much greater speed than heretofore. In other words, they will, in all probability, be able to go further and either run away from, or overtake the enemy, provided the enemy is aboard an old-style ship driven by reciprocating engines.

That there is a strong movement toward this end is evidenced by the announcement of the Westinghouse Machine Co. that they are to manufacture marine turbines for vessels of large size, and by the investigations now being conducted by the naval authorities, with a view to introducing the turbine.

Entered at the Post-Office in New York City as Second-class Matter.

# MACHINERY

DESIGN—CONSTRUCTION—OPERATION.

PUBLISHED MONTHLY BY

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We solicit communications from practical men on subjects pertaining to machinery, for which the necessary illustrations will be made at our expense. All copy must reach us by the 5th of the month preceding publication.

MAY, 1904.

NET CIRCULATION FOR APRIL, 1904,—24,926 COPIES.

MACHINERY is published in three editions. The practical work of the shop is thoroughly covered in the Shop Edition—$1.00 a year, comprising more than 430 reading pages. The Engineering Edition—$2.00 a year—contains all the matter in the Shop Edition and about 250 pages a year of additional matter, which includes a complete review of mechanical literature, and forty-eight 6 x 9 data sheets filled with condensed data on machine design, engineering practice and shop work. The Foreign Edition, $3.00 a year, comprises the same matter as the Engineering, but is printed on thin paper for transmission abroad.

One of our contributors has written us criticising the use of the word "standard" in connection with one of the data sheet tables issued with the *Engineering Edition*. He contends that while this sheet may have been a standard in the shop where it was developed it is in no sense a national standard, and that the term is therefore wrongly applied and might be misleading. Our contributor is right. The word has a broader signification than is applied to it, and is often used in too narrow a sense. We have in preparation, however, several data sheets to which the term "standard" can be applied without serious criticism. These sheets are to be made up from the tables that have been developed by the engineering staff of the Navy department and the Bureau of Steam Engineering for the use of draftsmen in those departments. We shall select the tables that will be of greatest value to the average designer or draftsman, and we believe they will be much appreciated by the many subscribers to the *Engineering Edition*. The data sheet this month contains as its leading feature what is probably the most complete tap-drill table for V-threads that has ever been published. It gives the sizes of drills varying by fractions of inches up to 2 inches in diameter, as well as machine screw sizes; and the point that will make the table of unusual value is that instead of denoting theoretical tap drill sizes the practical sizes are given—which are slightly larger than the calculated diameters. In other words, the table is a complete workable table for shop use.

* * *

## ARE WE EAGER TO LEARN?

A paper read before the Institution of Electrical Engineers gives a transatlantic view of American engineering education. The author, Dr. R. M. Walmsley spent three months last year in investigating our engineering schools, and succeeded in gathering a great amount of practical information which was of a flattering nature as a whole, especially in comparison with British conditions. Not only is the character of the engineering instruction upon the whole higher here than abroad, but the discrepancy in the number of students is startling. Dr. Walmsley found in sixteen of our prominent institutions 1,371 students in engineering courses who had been more than three years in attendance, while the latest available report in Great Britain showed but 56 students in the corresponding class. This difference does not so much indicate lack of facilities as difference in aims. Among first year and second year students, the comparison is upon more even terms, the truth being that with some distinguished exceptions the British technological schools are substantially what we would know here as trade schools, from which the pupils frequently pass into their technical pursuits without waiting to complete the course.—*Electrical World and Engineer.*

The foregoing note presents an interesting point in regard to the development of engineering education in America. This can be better appreciated when it is remembered that the development has come within the short period of 40 years. Forty years ago there were scarcely half a dozen institutions, outside of West Point and Annapolis, where students could obtain advanced instruction in civil engineering, while electrical engineering was, of course, unknown, and mechanical and mining engineering were scarcely thought of as subjects for study. But in 1862 there was passed the Land Grant Act, through the able efforts and keen foresight of the late Senator Morrill, of Vermont, which provided for the proceeds of the sales of public lands to go as a perpetual fund for the support of State colleges, where agricultural and mechanic arts were to be taught in connection with other studies. The object of the bill was to give an opportunity to those engaged in industrial pursuits to obtain some knowledge of the practical sciences and the mechanic arts which could then not be obtained at the classical colleges. The act gave a wonderful impetus to engineering education in America and is primarily the cause of the founding of many institutions not receiving government aid. It has led to the establishment of over one hundred technical colleges, and while these are small compared with the great German universities, and the total attendance is probably much less, engineering education is advancing by leaps and bounds in America, and according to Dr. Walmsley our students are more eager for advanced instruction than their English cousins, even if they are not yet on a par with German students.

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## SUPPRESSED DATA.

An important part of a liberal education, is learning "what not to do." There is a straight and narrow path which, followed, will lead to a certain desired goal, but until that path has been blazed through the wilderness of ignorance there is little guidance. It may be that after one way is found that numerous parallel paths leading to the same result will be discovered—usually by deduction which points them out when one set of facts has been conclusively demonstrated. But, while original research means numberless experiments and trials that give negative results, these results may be negative only as affects a certain desired end, and they might be valuable along another line of investigation. It, therefore, seems a pity that so much original work is lost to the world simply because it has not yielded the ends that the investigators desired.

Every large concern that has a testing department is constantly accumulating the experience of tests that, so far as the world at large is concerned, is lost. The world is only benefited in the concrete results of such tests as may appear in the shape of machines, processes or apparatuses. The negative facts are never known when very often, if they could be published, they would be of considerable value to the engineering world. But in making public negative results it would often be necessary to show the methods employed and that would amount to a disclosure of the general laboratory practice. Of course any firm or corporation is in general naturally violently opposed to the publication of their researches, as often about all that they have to show for it is that the "other fellow" will have to spend an equal amount of money to find out that something is not so. Those experiments that have proved successful are regarded as valuable assets. Mr. Morcom, an associate of the British Institution of Electrical Engineers, referred to the great mass of buried data that is in existence and expressed regret that such a condition existed, but it seems largely unavoidable. It is only when a firm is broad in its views that original work of this character is occasionally permitted to be made the subject of a paper to be read before some engineering society. Mr. Morcom suggested no remedy, and perhaps there is none.

## CUNARD COMPANY LEADS OFF.

The Cunard Company has taken the initiative in the matter of turbine equipment for fast transatlantic vessels by deciding to install turbines aggregating 75,000 horse power for each of two immense vessels that are about to be built. These vessels eclipse the *Kaiser Wilhelm II* in size and displacement, and it is expected they will develop a speed of 25 knots an hour and make the trip across the Atlantic in five days. The decision to use turbines in place of reciprocating engines came as the result of an extended investigation by a commission of experts made up of some of the most distinguished engineers of England and in spite of the fact that their report was not by any means altogether favorable to the turbine. It is believed that the turbines will weigh nearly as much as reciprocating engines of the same speed, that they will consume nearly as much steam, and that what little is saved in weight will be balanced by the larger auxiliary machinery required—such as larger condensers and air pumps, etc.—to take care of the much greater volume occupied by the steam at the high vacuum required for the economical operation of the turbines. It is held, however, that the smooth action of the turbines and the ease with which they can be cared for are sufficient arguments for their adoption.

Each of these Cunarders is to be fitted with four shafts. The two outer ones will be driven by high-pressure turbines and the two inner ones by low-pressure turbines. The inner ones will also be fitted with separate turbines for backward motion. It is not stated what type of turbine will be used, but presumably the Parsons, as this has been developed to the greatest extent in England, where the vessels will be built. We believe this type of turbine will give eminently satisfactory results, as the principles of operation of a large turbine are not to any extent different from those of a small machine. It is probable, however, that the weight of the Parsons turbine will be somewhat greater than that of some other turbines, because of the large number of rings of blades required in this type to completely expand the steam.

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## NOTES AND COMMENT.

A very peculiar and distressing accident by which a diver lost his life, occurred April 11 at the Rockaway River reservoir, near Boonton, N. J. The stem of one of the 50-inch valves in the outlet pipes was accidently twisted off with the valve about half open, and in order to make the necessary repairs a diver had to descend through the penstock. But this was a hazardous undertaking with the valve in a half-open position on account of the suction of the flowing water, so an attempt was made to shut off the flow of water by sinking a nine-foot wooden ball weighted with lead, over the inner opening of the pipe. It was expected that the ball would act as a check valve, as the pressure due to about a seventy foot head would hold it firmly against the opening. But in sinking the ball it did not lodge squarely over the opening so Hoar, the diver, descended in his suit to shift the ball into position. In some manner unknown he was caught between the ball and the end of the pipe, and there held for nearly four days despite extraordinary efforts to free him. At last another diver descended into the penstock and repaired the valve so that it could be closed, and only then was it possible to release the body.

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The T-section is so universally used for rails that it is a novelty to consider any other form or to think that any other practical shape might have any advantage. However, a German rail section is being introduced in the United States which is of inverted V shape, the inner and outer lines being parallel so that the same pair of rolls may be used for rolling rails of different weights. Moreover, the face of the rail is rolled harder than is possible with the T-section. It is claimed that this rail has six times the lateral strength and one-half more vertical strength than the present T-section rail of equal weight. With this rail no splice bars or bolts are used at the joints, the connection being made simply by using a short section of the same weight of rail placed underneath and within the V's of the track rails, so as to bridge the joint. By the use of wood blocks fitted in the V between the rail and the tie, a large elastic bearing is secured. The rail is held to the ties by spikes the same as the T-rail now in use. Should this rail be used it will seemingly require a considerable modification of the present forms of switches.

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The life of a miner is dangerous at best, and it would seem that safety devices for lessening or preventing accidents should be used wherever possible, but the introduction of the simplest appliances of this order seems very difficult. One of the ever-present dangers in cage hoisting is that of over-winding, that is, of not stopping the hoisting engine when the cage has reached the surface, the result being that the rope is broken and the cage hurled to the bottom of the shaft with its human burden. Two shocking accidents of this character have occurred in the United States within a few months, the men in one case falling a distance of 1,500 feet to their death. Now there are several safety devices of well-known efficiency for preventing just such accidents, known as "safety-hooks." The safety-hook connects the hoisting cable to the cage, and in case of over-winding the hook detaches from the cable, letting the latter whip around the drum without damage, and at the same time it locks the car to an overhead support, thus preventing its falling back into the shaft. When it is considered that hoisting engines operating deep shafts are run at high speed, it must be admitted that the danger of over-winding is great, and the wonder is that more such accidents do not occur. But to secure the general adoption of the safety-hook it will doubtless be necessary for all States to adopt compulsory laws for that purpose.

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An engineer (Mr. Edwin Reynolds) was asked some years ago to visit a copper mine in northern Michigan and design some ore-crushing stamps. He accordingly went to the mines, where, for the first time in his life, he saw stamps at work. He found them reared on a huge foundation of spring timbers and rubber sheeting, which was supposed to add to the efficiency of the stamps. His simple comment was "If I were trying to crush rock I would not start to do it on a feather bed." He suggested that the spring timbers be replaced by a solid mass of iron, so that the blow of a stamp should wholly expend itself in crushing rock, and not largely in compressing an immense elastic mass with utter waste of power. Only at the end of two years did the (Allis) company permit him to build such a stamp. It did just sixty per cent. more work than the old machinery. During forty years elastic cushions under every mining stamp in the world had been wasting almost one-half of the applied energy.—*World's Work.*

[The foundations of steam and drop-hammers have also suffered a similar change, the "feather bed" theory having been proven fallacious, but formerly such foundations were thought necessary to prevent breaking the dies and anvil blocks.—Editor.]

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### TEN YEARS TO GET RID OF THE ERRORS.

"In 1895 I published a mechanical engineer's pocketbook, of which more than 30,000 copies have been sold. The collection of the material for this pocketbook took more or less of my time for twenty years, and the making of the book not less than three years' full time. The things compiled in it involve reference to engineering works, papers and periodicals, some of them dating back at least 60 years. There are 1,100 pages in the book, and each page has about 900 words. The number of figures and formulæ in the book, which are based on the English inch, run into more thousands than I would care to figure. The task of getting such a book free from errors is a tremendous one. Over a thousand typographical and other errors have been reported in the last eight years. Mr. John C. Trautwine, Jr., told me some twenty years after his father's civil engineers' pocket was first published that he was only then beginning to feel that the book was reasonably free from errors. If my book were translated into the metric system, it would be at least ten years before all the errors in the translation would be rectified. I doubt if the translation could be made without at least five years' hard labor of an expert mathematician."—*William Kent, before the House Coinage Committee of Congress.*

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### OBITUARY.

Frank B. Kempsmith, formerly of the Kempsmith Mfg. Co., but for some time past retired from active business, died at his home in Milwaukee, April 10, aged 55 years. Mr. Kempsmith enjoyed a reputation in the machine tool field as a skillful mechanic and man of great ability. He was the originator and designer of the Kempsmith milling machine manufactured by the above-named company. Mr. Kempsmith was employed at different times and in different capacities by the Brown & Sharpe Mfg. Co., the Garvin Machine Co., and was also superintendent of the shops of Warner & Swasey, Cleveland.

# ENGINEERING REVIEW.

## CURRENT EVENTS, TECHNICAL AND MECHANICAL—LEADING ARTICLES OF THE MONTH.

A striking figure typifying the iron industry of the South, especially of Birmingham, Ala., is that of Vulcan, which will form part of that state's exhibit at the Louisiana Purchase Exposition at St. Louis this year. The statue was modeled in plaster in Passaic, N. J., by the sculptor Moretti and was shipped to Birmingham, where the castings were made. The figure is cast in 15 parts, the total weight of which is something like 100,000 pounds, and stands 56 feet high.

### CANADIAN PATENT LAW.

A recent consular report quotes an abstract of the Canadian patent law, which indicates that such patents become null and void unless the invention shall be continuously manufactured within the borders of Canada within two years from the date of granting the patent. The courts, however, have modified this clause so that if an inventor stands ready to supply a demand for his invention, that is, to build to order, it is held to satisfy the letter of the law. Another clause provides that the patent shall be forfeited if the invention is imported into Canada by the inventor or his legal representatives after the expiration of one year from the granting of the patent. From the foregoing it appears that the average Canadian patentee stands a much better show of losing his patent than he does of holding it.

Where it is difficult to obtain pulleys of exact relative sizes for synchronous operation of generators, or other purposes, the diameter can quite easily be increased one-half inch by means of a paper covering. To do this the pulley—no matter what material it is made of—should be thoroughly cleaned of all grease and oil and the surface roughed up by scraping or draw filing. Heavy manila paper cut to the right width is glued onto this surface, being careful to have the glue hot and not too thick. Press the paper firmly down on to the pulley face in starting and then draw the paper tight as the pulley is turned, pressing and pounding the surface carefully as each additional section is glued. When one complete cover is fastened to the face of the pulley the glue is applied to the exposed surface of the paper and the operation continued, being careful to see that no bubbles or wrinkles are left on the surface. If it is desired to make a crown on the pulley, this can be done by gradually narrowing down the width of the sheets which are being glued. This glued paper addition to the pulley forms a substantial, lasting surface and makes a very good surface for the belt to drive upon.—*Western Electrician.*

The manufacturer or exporter who would succeed in placing his wares in foreign markets, must carefully study the habits and customs of the people with whom he desires to deal. Not the least important consideration are the laws governing partnerships, contracts, etc. Judge Tourgee, the U. S. Consul at Bordeaux, France, says that a contract of partnership or for the purchase of realty or the sale of realty, or a contract of indemnity, is void and will not be recognized by the French courts unless drawn and executed by a notary public and it must be in the French language. A contract written in English, though attested by a notary public, is void. The Consul advises that the first thing for an American to do who seeks to introduce a business of any sort into France, whether by partnership, agency, or otherwise, should be to employ a competent legal adviser and consult him fully on all his affairs, not because those with whom he deals are any less reliable than other people, nor because the laws are less equitable in character, but because it is no easy matter to become as familiar with their application as with the common law, which is the basis of our business thought. It will not do to assume that the legal principles which govern and control business relations and responsibilities under our laws have any sanction except in Anglo-Saxon countries. Very many of the losses sustained by American exporters in their endeavor to find a market for their goods in France are traceable to their entire neglect to consider the legal conditions under which they must operate.

### BOILER MATERIAL AND BOILER CORROSION.

*Stahl und Eisen*, January 15, 1904, p. 82.

In an article on the above named subject the writer details some of the observations and investigations made by Engineer Diegel of the German navy. According to these observations, which were made in connection with a large number of plates, it has been found that

1. Of two plates in service in metallic contact with each other, and having different contents of phosphorus, sea water will corrode the one holding the higher percentage of phosphorus less than it will the one with the lower percentage. 2. Every indication is to the effect that two kinds of iron or steel when submerged in sea water form a galvanic cell, in which the metal that is rich in phosphorus is the cathode and will be more or less protected, while the one that is low in phosphorus becomes the anode and is rapidly corroded. 3. The iron that is low in phosphorus will corrode the more rapidly as its exposed surface is small in proportion to that of the metal having the higher percentage of phosphorus.

Diegel also made a large number of experiments with double plates suspended in iron vessels filled with fresh sea water. He found that the corrosion in sea water taken from open harbors was nearly twice as great as in that from the open, although it was frequently renewed. In these receptacles Diegel also tested unsubmerged double plates, made of different qualities of metals, and also some half submerged in sea water, the upper portion being sprinkled with the same every day. These experiments gave the following results:

In the case of the half submerged plates that were separated from each other, the influence of the phosphorus is still evident, even though it is not very great. As the content of phosphorus increases the corrosion decreases.

In contradiction to the experiments of Diegel are those of Chief Engineer H. Otto, who exposed test specimens of different kinds of metal to the atmosphere, to warm damp air, to warm feed water, to service in a boiler, and to artificial sea water, and found that the different percentages of contained phosphorus had no marked influence upon the rapidity of the corrosion of the metal.

Diegel acknowledges that his results obtained in sea water need to be verified by tests in boiler service, but, at the same time, he is very confident that the rate of corrosion between iron plates, poor and rich in phosphorus, will be thoroughly established, and that if a small iron plate containing less than .01 per cent. of phosphorus be used in a boiler with iron containing about .09 per cent. of phosphorus, it will be entirely eaten away in a short time. But boilers are not fed with sea water, so that Diegel's results do not have a direct bearing on boiler corrosion except to point out a general tendency. He, however, insists most strenuously that, in order to secure the greatest freedom from corrosion, it is advisable to use steel made from the same heat or at least that having the same phosphorus content. The author does not consider that Diegel has presented data enough to prove his point, but, at the same time acknowledges that the matter is worthy and should be made the subject of, further investigations.—G. L. F.

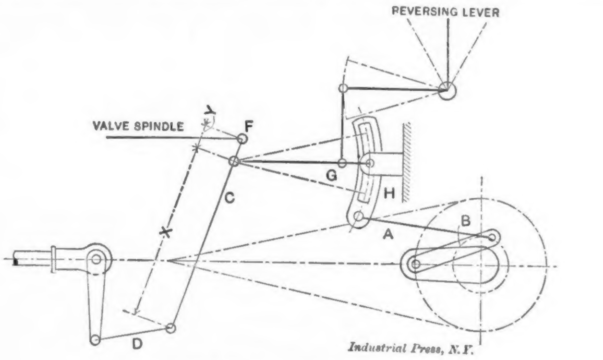
### ANALYSIS OF THE WALSCHAERT VALVE GEAR.

*Mechanical Engineer*, April 1, 1904, p. 162.

The valve gear known as "Walschaert's" is extensively used on European locomotives. It probably owes its success to the arrangement of the levers, etc., which permit of the steam chests of the cylinders being placed above instead of on the side, a result which is not obtained by the Stephenson, Gooch, or Allan link motions without the use of rocking levers or other complications. This consideration, together with the

space saved on the main axles by the absence of eccentrics, is an important advantage in large locomotives, or for locomotives of very narrow gage. Its advocates also claim that inasmuch as the gear is exposed to view and easily accessible, it is more likely to receive proper lubrication and adjustment than those gears which lie between the frames and under the boiler. It must be admitted, however, that this claim has but little weight.

The accompanying illustration shows the gear in outline only, but it is sufficient for the purpose of analyzing the action of the various levers. The rod *A*, which actuates the link is driven by a return crank *B*, the center or crankpin of *B* being at such an angle to the main crank that when the latter is on the dead center the link *H* will be in its central position. Neglecting for the present the effect of the levers *C* and *D*, it will be seen that the arrangement would form a suitable reversing gear for operating a valve without lap and lead, always provided that the reversing handle be placed in full gear either forward or backward. Now whatever the amount of lap and lead given to the valve, they must be accounted for by the lever *C*, which derives its chief motion from the crosshead through the medium of the link *D*. As to the valve itself, it may be designed in exactly the same manner as a valve driven by an eccentric, the lap, travel, etc., being found by Zeuner circles. Having determined the lap and lead, we set out the position of the link when the main crank is on the dead center. The pin of the return or valve crank *B* will then




**The Walschaert Gear.**

be at half stroke. Meanwhile the crosshead will be at the extreme limit of its stroke, and therefore the lever *C* must throw over the center *F* by an amount equal to the lap plus the lead; hence the lengths of the two arms of the lever *C* must bear the same proportion to each other as the lap plus lead bears to the length of the crosshead movement. When the pin *A* is at extreme position, either front or back, the crank is at half-stroke, consequently the lever *C* will move the valve over somewhat more than is due to its motion from the return crank. This must be allowed for in the design. *X* and *Y* being the lengths of the long and short arms of the lever *C*, and *T* being the proper full travel of the valve, the motion received by the valve spindle from the pin of the return crank *B* must be less than the proper full valve travel by an amount equal to $\frac{T \times Y}{X}$.

To obtain the best results with this gear, the reversing link should be suspended at the center; the suspension rods should be as long as convenient, and the lifting levers should connect to the radius rod *G* as near the link block pin as possible. Attention to these points will reduce the slip to a minimum. On trying this gear round it will be found that, if properly designed, a constant lead is given for all positions of the reversing handle, but otherwise the steam distribution is practically identical with that of a Stephenson or Allan link motion.

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### PEAT AS FUEL IN GERMANY.

*Consular Report No. 1925.*

Raw peat as it comes from the bog in all but exceptionally high and dry locations contains usually 85 per cent. of water. Experience has shown that the remaining 15 per cent. of peat substance, if dried and burned as fuel, contains only heat units sufficient to evaporate 28 per cent., or one-third, of the 85 per cent. water which the crude material originally contained. This is the fatally weak point in all artificial peat-drying processes. They consume more heat units than they can produce. The essential point is to eliminate by drainage and air drying every possible atom of water. This is done by two methods, dependent somewhat upon the use for which the prepared peat is designed.

In all cases, however, good management includes as a first step the drainage of the bog by ditches, cut at intervals to a depth of about 18 inches below the bottom of the peat bed which it is designed to work. Into these at least 50 per cent. of the water settles and either flows off by gravity or is pumped out by the wind-driven pumps. The drained peat is then excavated, either in blocks, cut with an angle spade specially designed for the process, which are hauled away in hand cars and laid out on the ground to drain and dry by wind and sun, or by machines which by means of steel scoops or diggers running on an endless chain dig out the peat, carry it up to a sufficient height, and dump it into hand cars, which transport it to the machines, by which it is further treated and prepared.

A complete plant of this kind, which was exhibited in constant operation by Mr. C. Schlickeysen, of Rixdorf-Berlin, formed a prominent feature of the first exposition of the Association for the Promotion of Moor Culture held in Berlin this year. The excavating machine, which was driven by an electric motor, was mounted on a portable track of light rails, designed to be moved over the moor as the peat is exhausted by excavation. The machine digs out, elevates, and drops into the dump cars a ton of raw peat every five minutes. It is transported to the machine, conveniently located at the edge of the bog, which tears, pulverizes, kneads, and presses the plastic mass out into long masses or "strains." These are cut into sections a foot long and dried in the open air to hard, tough blocks, which resist rain and bear transportation to any distance. The secret of this part of the process seems to be that the crushing and grinding action of the machine releases the fluid organic elements of the raw peat, and these mix with the solid fibrous portion, forming a matrix or binder which when dry holds the whole mass firmly together. In drying, the strains shrink to about one-half their size when in a plastic state. If mixed while in a soft condition with 20 to 30 per cent. of anthracite or bituminous coal dust they form when dry an excellent fuel of high calorific value. Otherwise, they may be carbonized by heat into peat coal or coke.

Both the latter are pure and free from sulphur or phosphorus, and are therefore valuable fuel for the finer processes of metallurgy, but they are inevitably too expensive to compete on a large scale with ordinary coal and coke. Any form of peat fuel, in fact, represents the recovery of a small percentage of crude vegetable matter from a large proportion of water and the preparation of this residue by processes which are inevitably so laborious and expensive that unless the most improved and economical methods are employed at every stage the cost exceeds the fuel value of the product.

Notwithstanding all difficulties, however, progress in the preparation and use of peat fuel is steady and constant, and Sweden, according to recent reports, has succeeded in utilizing it for locomotives. On the government railway from Elmhut to Malmo specially constructed freight locomotives have been fired during the past year either wholly with peat fuel or a mixture of the same with English coal, and the engineer's reports claim for the experiment both a mechanical and economic success.

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### MULTIPLE EXPANSION STEAM ENGINE.

*Der Practische Maschinen Konstrukteur*, January 21, 1904, p. 10.

Fryer & Co., of Rouen, France, have recently brought out an interesting four-cylinder multiple expansion steam engine whose general scheme of construction is shown in the section Fig. 1; Fig. 2 also shows a stationary engine; and Fig. 3, one that is reversible. The engine is also made in a form adapted to automobiles. Under each of these conditions four cylinders are used and they are arranged in the form of a cross with the connecting rods of each taking hold of one and the same crank pin. Of the four cylinders, three are of the

same diameter while the fourth cylinder has twice the diameter of the others, and so serves as the low-pressure cylinder. The steam distribution for all four of these cylinders is effected by means of piston valves driven from a single eccentric. It depends upon whether the engine is built as a stationary or reversible engine as to what modifications shall be made in the movement and attachments of the eccentrics. In the first case there is a direct connection by means of the usual eccentric rod, but in the second some extra parts are introduced, as in Fig. 3.

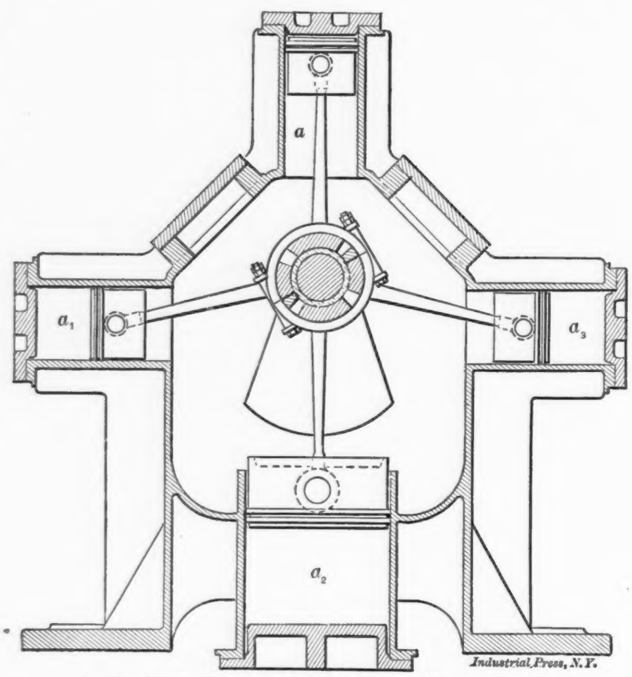



Fig. 1. Cross-section of Multiple Expansion Steam Engine.

The regulation to varying loads is taken care of by the adjustment of the distributing valve $k$, shown in Figs. 4 and 5. Here the shaft of the handwheel carries a pinion that meshes with a rack attached to the back of the valve by which the latter may be moved to and fro. In this way it may be set in any one of the positions corresponding to as many variations of power development by the machine. This distributing valve is about the size of the piston valve and is fitted with two D's of unequal size by means of which the group of ports 1, 2, 3, and 4, 5, 6 can be put into communication with each other. The attendant is thus in a position to admit steam into one or into all three of the high-pressure cylinders, and thus change the power development of the engine at will, it being the least in the first instance and greatest in the last.

When working at its lowest power and highest efficiency the steam enters the valve chest $k_2$ from the boiler which is in communication with the passage $h$, Fig. 2, by another cast in the work. This passage $h$ is cut off from the cylinder $a$ by the piston valve $b$. The steam then has free access to the cylinder through the valve $b$, where it does its work, and is exhausted through the cavity 8 in the piston valve $b$ and thence passes through the port 3 into the D cavity of the valve $k$. From here it issues through the ports 1 and 2 into the other two small cylinders $a_1$ and $a_3$ which, in this case, act as intermediate cylinders as long as the distributing valve directs the steam movement in this way. From the cylinder $a_1$, the exhaust steam flows through a passage cast in the casing to the port 4, which is in communication with the steam chest of the low-pressure cylinder $a_2$. This exhaust, then, does not pass through the distributing valve $k$ at all, while the exhaust from the cylinder $a_3$ is also discharged through the distributing valve into the port 4. Finally the exhaust from the large cylinder $a_2$ is discharged through the interior of its piston valve into the casing of the engine whence it escapes into the air or is led off to the condenser. From what has been said it will appear that, in order to effect the greatest economy, the engine works as in triple expansion when developing the lowest amount of power.

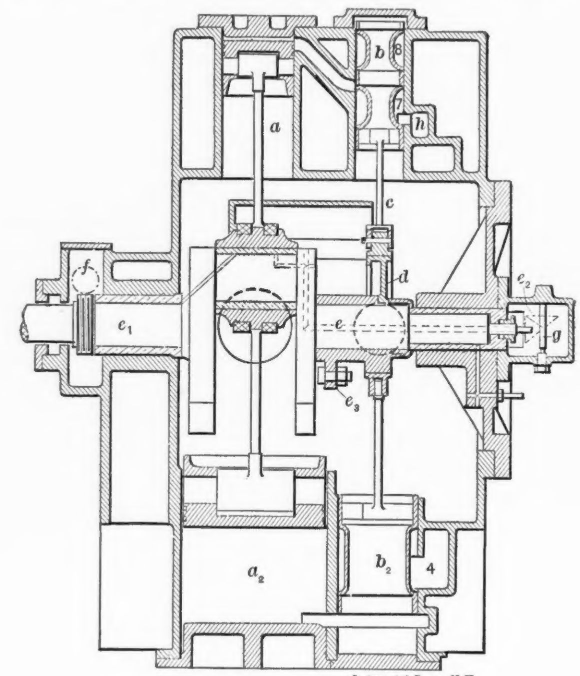



Fig. 2. Longitudinal Section.

If, now, the distributing valve $k$ is so adjusted that the lip $k_3$ is over the bridge $u$, the first combination for the working of the engine as a compound is obtained. The live steam is no longer admitted to the cylinder $a$ alone, but also to $a_1$ through the passage that has now been opened. When it has done its work in these two cylinders, a part of it is exhausted into the third small cylinder $a_3$ while the balance goes to the large cylinder $a_2$. It thus passes into the space 9 of the distributing valve which has now put the exhaust port 3 in connection with the port 2 and 4. As already stated the large cylinder still remains connected with the exhaust pass-

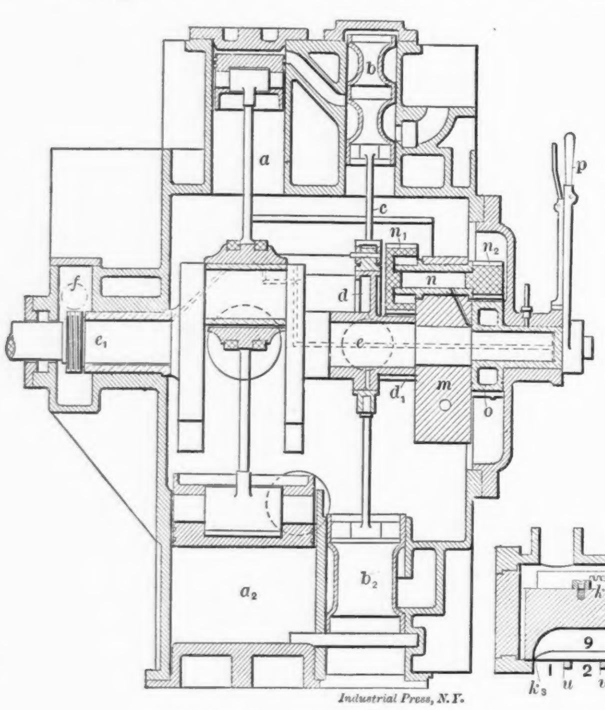
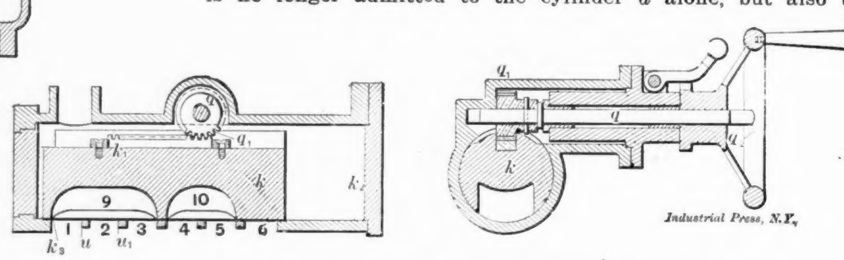



Fig. 3. Reversing Engine.




Figs. 4 and 5. Longitudinal and Cross-section of Reversing Valve.

age of the cylinder $a_1$. The power developed is now greater than it was before, but the economy is less.

When the distributing valve $k$ is moved so that its lip $k_2$ is over the bridge $u_1$, the second combination for compound action is obtained, and the engine will then be developing its highest power. Live steam is then admitted to all three of the small cylinders, $a$, $a_1$, $a_2$, at the same time, without giving the distributing valve $k$, any influence whatever over the steam admitted to the first cylinder $a$. The other two cylinders, $a_1$ and $a_2$, now take steam through the ports 1 and 2. After having done its work in the three small cylinders the steam is exhausted into the large cylinder $a_3$. In the case of the cylinder $a_1$, this is accomplished by connecting the

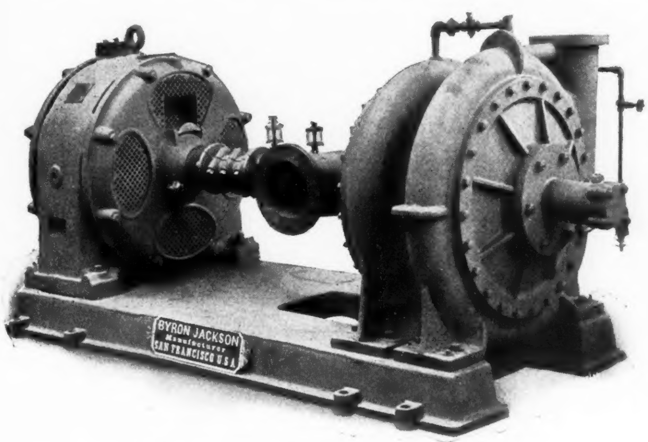



Fig. 1. Horizontal Multi-stage Turbine Pump.

ports 3 and 5 through the cavity 9 of the distributing valve. In this case the port 6 and the cavity 10 serve as an auxiliary exhaust.

According to the foregoing description the distributing valve makes it possible to run the engine under three different conditions of power development. The first of these is in triple expansion in which two of the small cylinders act as the intermediate, and there is a single one acting as the high pressure. The second is as a compound with two small cylinders working as high pressure and one small and the large working low-pressure. The third is where all three of the small cylinders work high pressure and the large one alone serves as the low. G. L. F.

## HIGH-PRESSURE MULTI-STAGE TURBINE PUMP.

*Engineering News*, March 7, 1904, p. 324.

To apply electric motors to the work of pumping, rotary or "centrifugal" forms of pump are almost essential. The objection to the conventional style of centrifugal pump for most classes of pumping service is its unsuitability for working against even moderately high pressure. Moreover, even at the most favorable pressure for a given pump of this kind, its efficiency is not very great, possibly 60 per cent. as a maximum, falling off rapidly as the pressure increases or diminishes.

High efficiency in centrifugal or rotary pumps need not primarily be considered a desideratum. Ability to pump against high heads, however, is absolutely essential to any great extension of the field of usefulness of the rotary pump. This fact lent great value and interest to the introduction of a type of pump developed in a scientific manner from the principles governing turbine construction. European engineers were the pioneers in this. Turbine pumps of excellent design, suited for very high heads and giving satisfactory efficiency, have been built in Europe for a number of years. More recently American pump builders have entered the same field. Some illustrations and data of the turbine pumps of one American maker, the Byron Jackson Machine Works, of San Francisco, Cal., are given in the following:

It is to be noted that centrifugal pumps of the ordinary kind have in some cases been adapted to heads higher than a single pump could serve, by coupling them in series, so that each pump worked against only a part of the total delivery head. Essentially the same thing must usually be done with turbine pumps, with the difference that in this case each separate pump or "stage" is able to pump against five to ten times the limiting head of the ordinary centrifugal pump. This difference is wholly due to careful design of the impeller blades and the addition of guide passages (like those in turbines) for the purpose of converting velocity into pressure with minimum eddy losses. The pumps shown and described in the following are multi-stage turbine pumps of this kind.

The operating elements of the Jackson pumps are rotating impellers containing spirally-curved water passages, and fixed guide passages between successive impellers. The water enters the passages of each impeller at the center and by the rotation is forced out to a collecting chamber surrounding the periphery of the impeller. The ducts which lead the water from here back to the center of the next impeller are suitably curved to act as guide passages, similar in action to the guide buckets of a turbine. The water then enters the next impeller in an axial direction, its rotary motion having been transformed by the guide passages into rectilinear motion.

Fig. 3, a drawing of a vertical pump section, shows the relative arrangement of impellers *A* and guide passages *B*. The pump shown has the suction entrance at the top; the discharge leaves the collecting chamber of the last (lowest) impeller in a tangential direction. The shaft rests in a thrust bearing at the top, and is further held by bearings formed in the successive sections of the case. At the bottom it is provided with a special balancing arrangement, described below. Each impeller, where it joins the guide passages of the preceding case section, is fitted into the case so as to form as tight a joint as possible without introducing any great frictional resistance to rotation. With the exception of the entrance opening, the external surface of the impeller is exposed to the delivery pressure, so that there is a resultant upward pressure on each impeller, equal to the area of its

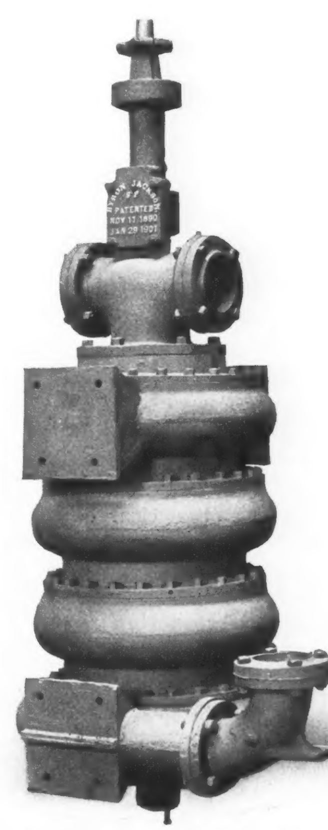


Fig. 2. Vertical Multi-stage Turbine Pump.

entrance multiplied by the difference between the entrance and discharge pressures of that stage. If all the impellers are alike, the total upward thrust is equal to the product of entrance area multiplied by the total head on the pump. The pumps are so proportioned that this upward thrust slightly exceeds the weight of the rotating portion, consisting of impellers and shaft. The excess of upward pressure, however, is relieved by the balancing device located at the lower end of the shaft, with the result that the rotating part is pre-

cisely balanced, thus relieving the thrust bearing of all load while the pump is running.

The balancing device referred to consists of two chambers, $C$ and $D$, formed centrally in the bottom of the lowest section of the pump case. The large chamber $C$, incloses a projecting hub, $E$, on the lower surface of the impeller. This hub of course rotates with the impeller, and the joint between the hub and the walls of the chamber is, therefore, loose enough to allow water from the delivery side of the last impeller to leak into chamber $C$ and establish the full discharge pressure in that chamber. The small lower chamber, $D$, contains a plug $H$, which may be adjusted endways by means of screws. The forward end of this plug fits closely into a recess in the face of the hub, $E$, which recess communicates, by way of the hollow central part of the hub and the passages $g$, with the entrance side of the last impeller. The action of the device is as follows: When chamber $C$ becomes filled with water, or rather when leakage through the joint around the hub $E$ has raised the pressure in the chamber $C$ to the delivery pressure, the total upward pressure on the impellers is greater than the total weight of the rotating part of the pump. The rotating element is therefore lifted until the recess in hub $E$ is raised clear of the plug $H$. In this position the pressure in chamber $C$ is relieved through the passages $g$, with the result that the rotating element again settles down over the adjusting plug $H$. As this action tends to recur, a position of equilibrium is established near the point where the plug just enters the recess in the hub $E$. The precise position of this point may be altered by the adjusting screws of the plug $H$, thereby adjusting the endwise position of the impellers in the casing. When the pump is not in operation, of course the upward pressure of the water does not act, and the weight of the rotating part must be carried by the thrust bearing.

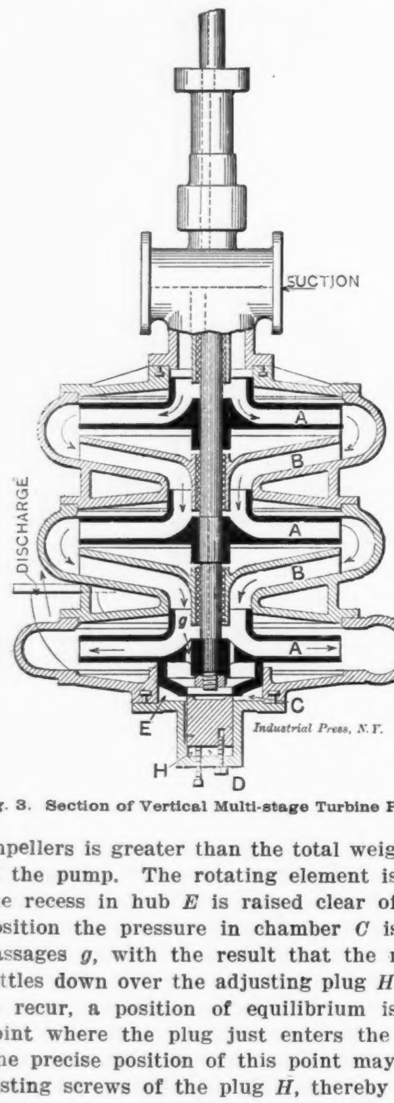



Fig. 3. Section of Vertical Multi-stage Turbine Pump.

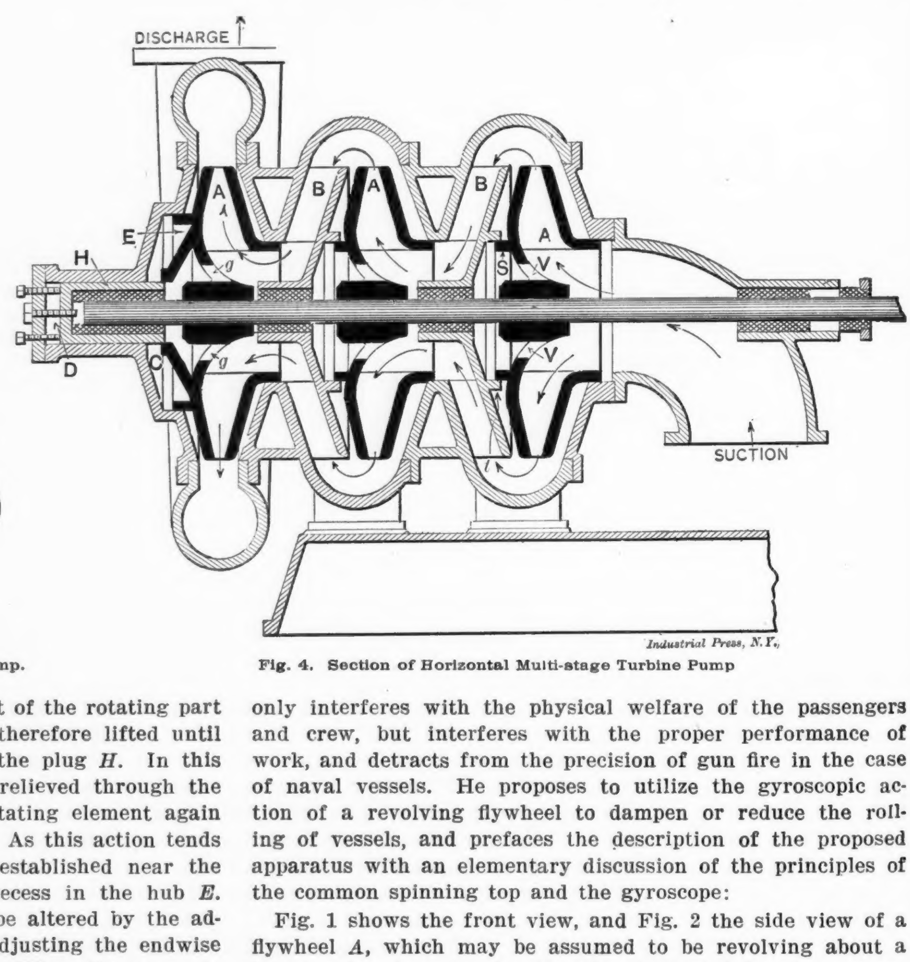



Fig. 4. Section of Horizontal Multi-stage Turbine Pump

When these pumps are built with horizontal shaft, the unbalanced pressure which is thus turned to account in the vertical pump becomes harmful and must be avoided. The arrangement by which this is accomplished is shown in Fig. 4, where the letters $A$ and $B$ designate respectively the impellers and the guide passages as before. The rear of each impeller—that is, the side opposite the entrance opening—bears a short annular projection, $S$, fitting within a similar ring $t$, projecting from the casing. The circular chamber formed by these two rings communicates, through holes, $V$, in the web of the impeller, with the entrance side of the impeller. The chamber being slightly larger than the entrance opening of the impeller, it serves to eliminate all thrust on the impeller in the direction of the suction (since the remainder of the external surface is exposed to the discharge pressure), and produces instead a small thrust directed toward the discharge end. This small resultant thrust is taken up by a balancing device at the end of the shaft precisely similar to that used in the vertical type of pump, as described above. The balancing action thus secured serves to fix the endwise position of the rotating part; moreover, it affords sufficient margin to compensate for longitudinal thrusts which may result from causes such as slightly non-central position of the impellers in their casing.

Pumps of this design are built for heads of from 100 to 2,000 feet, the number of separate impellers or "stages" being properly proportioned to the head. About 100 to 250 feet head per stage appears to be allowed. A high efficiency of working, from 70 to 80 per cent., is said to be realized.

## GYROSCOPIC EFFECT OF FLYWHEELS ON BOARD SHIP.

*Abstract of Paper read by Otto Schlik before the Institution of Naval Architects, March 24, 1904.*

The author begins his paper by stating that ever since our forefathers began to navigate the seas, the tossing and rolling to and fro of vessels has been an unpleasant feature. It not only interferes with the physical welfare of the passengers and crew, but interferes with the proper performance of work, and detracts from the precision of gun fire in the case of naval vessels. He proposes to utilize the gyroscopic action of a revolving flywheel to dampen or reduce the rolling of vessels, and prefaces the description of the proposed apparatus with an elementary discussion of the principles of the common spinning top and the gyroscope:

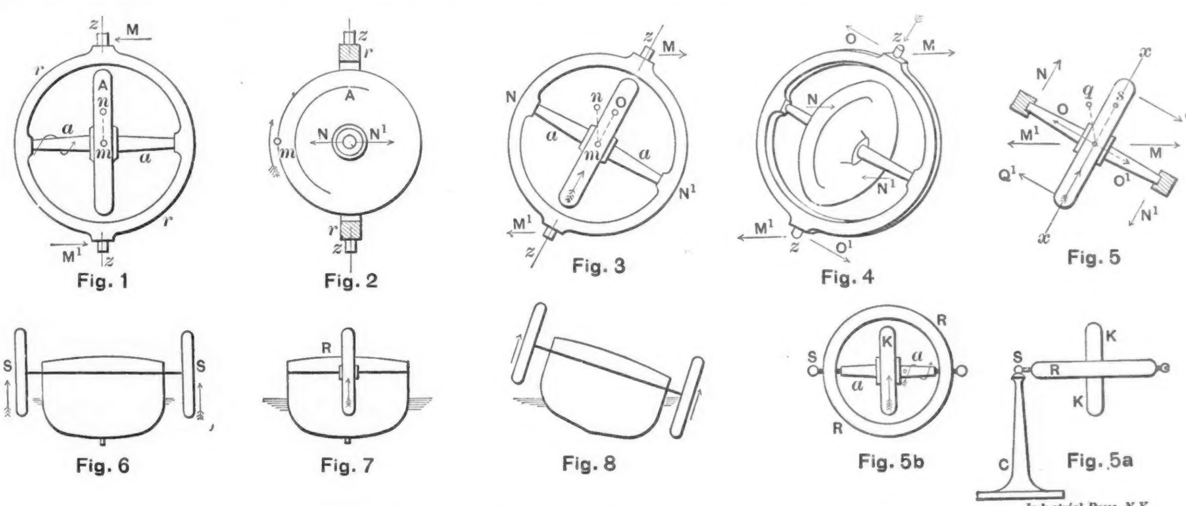
Fig. 1 shows the front view, and Fig. 2 the side view of a flywheel $A$, which may be assumed to be revolving about a horizontal axis $a$ in the direction indicated by the arrows. The axis $a$ is borne in a ring $r$ $r$, which can revolve in the journals $z$ $z$, about an axis which is first assumed to be vertical. A particle of mass $m$ on the circumference of the flywheel has for an instant a velocity in the vertical upward direction, and has, according to the law of inertia, the tendency to preserve both its speed and its direction of motion. It may be assumed that by the action on the system of an extraneous couple $M$ $M'$, the ring $r$ $r$ is turned in its own plane through a certain angle, so that the axis $a$ $a$ of the flywheel becomes inclined, and takes the new position shown in Fig. 3.

While the particle $M$ of the flywheel periphery in Fig. 1 is making for $n$, the inclination of the axis $a$ $a$ occurring simultaneously would compel it to go to $o$. But, since we have assumed that the ring $r$ $r$ can revolve in the journals $z$ $z$, and

consequently that the axis $a$ $a$ also can turn in a plane that is at right angles to one in which the turning was first brought about by the couple $M$ $M'$, it thus becomes possible for the point $m$ (see Fig. 3) to reach $n$ instead of $o$, the axis $a$ $a$ turning the while in the plane lying at right angles to that of the diagram in Fig. 3. In this the end of the axis $a$ $a$ marked $N'$ will move toward the spectator, and the end $N$ away from him, and the whole will assume a position such as is shown in perspective in Fig. 4.

A particle of mass lying on the back of the flywheel at the point furthest removed from $m$, is, as may readily be seen, subject to the action of exactly similar forces, which also tend in the same manner to produce a turning of the axis $a$ $a$. If the flywheel, assumed in the position illustrated in Fig. 4, be viewed in the direction of the large arrow, it appears as illustrated in Fig. 5. The plane of the flywheel is caused to turn by a second couple $Q$ $Q'$ or $N$ $N'$, and is brought into the new position $x$ $x$. In view of this, the direction of motion of a particle of mass $q$ of the periphery will also be diverted, and instead of reaching $q$ will be forced to move to $s$. By this another (third) couple $O$ $O'$ is produced, in the same manner as was above illustrated, acting almost in direct opposition to the first one $M$ $M'$, which produced the turning $r$ $r'$ of the ring, and having the tendency to prevent the latter from turning. This third couple $O$ $O'$ cannot come into existence if the inclination of the axis of the flywheel can take place only in one single plane. That is tralizes the first one resulting from the action of gravity, so that the weight of the ring with the flywheel apparently disappears altogether.

An ordinary paddle steamer possesses two wheels of equal weight, which, it is true, turn at a comparatively small velocity, but the influence of which must, according to what has been said, to some extent make itself felt. Their effect, so far as the conditions above illustrated come into play, is exactly the same as if two flywheels were hung one on each side of the vessel, having the same angular velocity and the same moments of inertia as the paddle wheels. The effect produced by these two flywheels $S$ $S$, Fig. 6, would be in nowise altered if they were replaced by a single wheel $R$, Fig. 7, within the the vessel, having a moment of inertia equal to the sum of the moments of the two. The effect of these assumed flywheels is similar to that seen in Figs. 1 to 5. In Figs. 6 to 8 the cross section of the vessel is viewed from the stern. The effect of the wheels makes a paddle-wheel steamer behave materially different from a screw steamer in a sea way. When a paddle steamer heels to starboard, and the starboard wheel in consequence dips further into the water, a turning of the vessel ensues, not to port, as one would expect, but to starboard, and *vice versa*. In fact, the gyroscopic influence of the paddle wheels on the steering in part counterbalances the influence exerted by them on the water. Otherwise it would be still more difficult than it now is to keep a straight course with a paddle steamer in stormy weather.




**Illustrating Action of Gyroscope as Affecting Flywheels on Board Ship.**

to say, if the ring $r$ $r$ were not made capable of being turned about the journals $z$ $z$, and the imparting to the flywheel of the deviation illustrated in Fig. 5 became impossible, no obstacle to the action of the original couple $M$ $M'$ would present itself. The rapidly revolving flywheel would allow itself to be brought into the position illustrated in Fig. 3 with the same ease as if it were at rest.

The above described properties of the gyroscope are familiar in a somewhat different form in connection with the well known toy known as the Archimedean top. The latter consists essentially of a small flywheel $K$, Figs. 5$a$ and 5$b$, which is borne in journals in a ring $R$ in such a manner that it can easily rotate about the axis $a$ $a$. If the flywheel be made to rotate rapidly and the ring be supported at the point $S$ by means of a ball-like projection resting in the cup-shaped head of a stand $C$, the ring does not respond to the influence of the force of gravity by falling from the stand, as it might be expected to do, but remains poised in the horizontal position, and turns slowly in the horizontal plane round the point $S$.

The same phenomena are here observable as were illustrated above. The force of gravity in the first place acts on the ring bearing the flywheel and resting on a support at one side, so as to try to move ring and flywheel downward, which action causes a turning of the axis in a vertical plane. This turning (or twisting) movement produced by the first couple in this case also brings a second couple into play, which produces the clearly observable rotation of the ring about the point $S$ in the horizontal plane through the latter. This rotation in its turn brings the third couple into play, which neu-

The phenomena which present themselves in connection with an arrangement of this kind may best be studied by the help of a model, such as that illustrated in Fig. 9. This shows a pendulum which is able to swing to and fro on an axis at $n$. Above, the pendulum takes the form of a semicircular fork-piece $B$. A ring $R$ is hung on the point of the screw pins $p$ $p$, in such a manner that it can turn about a horizontal axis through the center of the fork-piece. In the ring itself, which is so weighted at the point $S$ that, when inclined by any means, it will always return to the upright position, a vertical spindle $a$, carrying the flywheel $F$, is set in bearings. If the pendulum be set swinging without the flywheel being made to rotate, it will be found to move to and fro with a certain definite period. The frame in which the flywheel is borne may first be allowed to move as easily as possible—i. e., with a minimum of friction. If the flywheel be then set spinning and the pendulum receive a push, the latter will, in the first place, show a considerably increased period of swing.

The flywheel oscillates with its frame during the swings of the pendulum with a so-called phase difference of 90 degrees—that is to say, the swings of the axis of the flywheel keep lagging behind those of the pendulum by a quarter of a swing. While the pendulum is passing its central (vertical) position, the axis of the flywheel will show its greatest inclination; and when the pendulum is in the outermost position of its swing, the axis of the flywheel stands exactly in its middle position. The amplitude, or extent of the swing, of the pendulum will, as theory tells us, not be influenced thereby, but will remain exactly as great as before. That this is the case

will also be readily apparent, since no consumption of energy takes place in the apparatus, the period only being influenced by the increase which takes place in the swinging mass.

Were it possible to fit a flywheel of this kind, able to swing in its frame without experiencing friction, into a vessel, this would be advantageous in so far that, to begin with, the rolling motions would become slower, and therefore less unpleasant; and then, on account of the great difference thus produced between their period and that of the waves, they would cease to be of any consequence. The rolling motions of the vessel would then become considerably less in extent. If the frame which bears the flywheel be screwed tight on the model, so that it can no longer turn, the effect hitherto produced by it will cease, and the pendulum will swing with the same period as it would if the flywheel were not rotating.

It will readily be seen that the effect produced upon the swings of the pendulum by the rotating flywheel can be of greater extent only so long as the plane of the frame bearing the flywheel remains approximately vertical.

If the axis of the flywheel be inclined at an angle $a$ to the vertical, the moment thus produced, acting against the motion of the pendulum, will be proportional to the value of cos. $a$. Should the axis of the flywheel momentarily become horizontal, a position which with a pendulum in violent motion it may almost reach—that is to say, should $a$ equal 90 degrees and cos. $a$ equal 0—the influence of the flywheel will disappear altogether.

maximum angle attained becomes considerably reduced with each successive swing, so that a state of rest is reached even after two complete swings. In scientific language, the oscillations of the pendulum experience a damping, in that the energy stored up in it is destroyed by the friction applied to the flywheel frame.

The gyroscopic action of a rotating flywheel has in the above been illustrated as applied to a pendulum. It will readily be seen that it may be applied in a similar manner to retard the rolling motions of a vessel. In Figs. 10 and 11 the vertical axis of the flywheel $W$ is set in bearings in a large frame $F$ $F$, which can turn on the journals $P$ $P$, about a horizontal axis lying at right angles to that of the vessel. It may be made to rotate rapidly by means of an electric motor or a steam turbine.

Fitted to the frame is a journal $p$, which is connected with the piston rod of one or of two hydraulic brake cylinders $C$, and, by the throttling of the area of the communication tube, enables the swings of the frame $F$ $F$ to be braked at will. The frame is ballasted at its lower side by a weight $G$, as was done on the pendulum model, or the journals $P$ $P$ may be fitted somewhat above the position of the center of gravity of the whole frame. As soon as any outside influence begins to heel the vessel over in a direction at right angles to its length, the flywheel frame will incline considerably, with the result, as in the case of the pendulum model, that moments are produced which not only render the oscillations of the

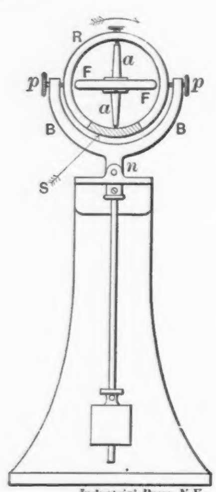



Fig. 9.

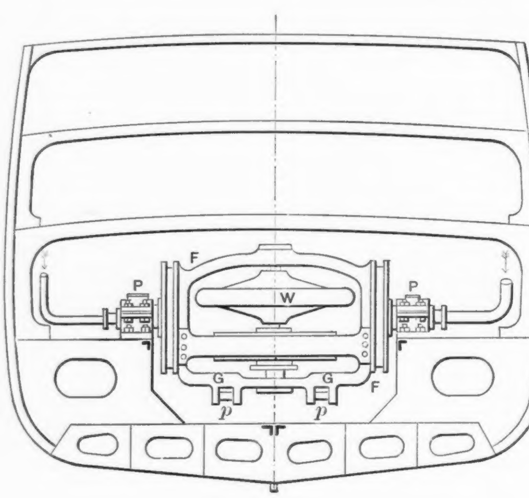



Fig. 10.

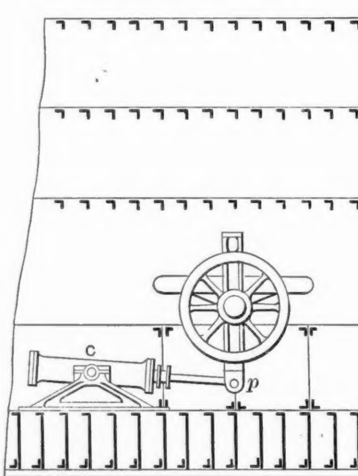



Fig. 11.

Since, as already stated, there is a phase difference of 90 degrees between the swings of the pendulum and those of the axis of the flywheel, the gyroscopic influence on the pendulum must be least in amount when it is passing the middle position—i. e., at the very position at which it has its greatest angular velocity, because at the same moment the inclination of the axis of the flywheel is at its greatest, while the velocity with which it is changing its inclination has become very small or vanished altogether. When, on the other hand, the pendulum has reached its outermost position, and is changing the direction of its motion, thus for an instant reaching a state of rest, the axis of the flywheel then proceeds with its greatest angular velocity through the middle position, the flywheel thereby exerting its greatest influence. It will thus be evident that the conditions for the exertion of the greatest possible influence of the gyroscopic action of the pendulum are not present here. In order that the motion of the pendulum may be effectively influenced, the oscillation of the frame with the axis of the flywheel will have to be reduced in a suitable degree. In the model illustrated in Fig. 9, this may be most simply effected by tightening the screws to a suitable extent, so that they act as a brake on the motion of the flywheel. The swings of the flywheel frame are thus reduced in extent, and the phase difference between the two swinging movements here described now becomes less than 90 degrees.

If the experiment be made of setting the pendulum swinging with the brake thus applied to the flywheel frame, a very different phenomenon will be observed. The pendulum will indeed still swing with a very considerable period, but the vessel considerably slower, but also very considerably reduce their extent. But these two conditions are exactly the ones which alone are calculated to destroy the rolling motions caused by the waves. A vessel fitted with the appliance illustrated would, according to this, only be subject to insignificant rolling motions. On the other hand, the frame, with its flywheels hung up within the vessel, would swing violently to and fro.

In addition to the hydraulic brake, it will be necessary to fit one or two powerful band brakes, which will enable the flywheel to be held at large angles of, say, more than 45 degrees in stormy weather, which would be under the control of a man told off for the purpose.

In order to show the effect of a flywheel on board a medium steamer, calculations for one of 6,000 tons displacement have been worked out. The vessel has a metacentric height of 17$\frac{3}{4}$ inches and a period of 15 seconds for the double roll when there is no flywheel. Now if on this vessel there be a flywheel 15 feet diameter, weighing 22,000 pounds having a peripheral speed of rotation of 656 feet per second, the effect on the rolling motions is very pronounced. The total weight of the flywheel, with its swinging frame and motor, is taken to be about 45,000 pounds, and the arrangement of the axial trunnions of the frame is assumed in one case to be such that the distance $r$ equals 19$\frac{5}{8}$ inches. Under these conditions the angle of swing is reduced after one oscillation to 0.3, the starting angle. Thus, when the vessel has been inclined 4 degrees from the upright, it will, with the next roll, reach an angle of inclination of only 1 degree, etc.

# TOOL MAKING.—6.

## TAPS (Concluded).

E. R. MARKHAM.

### Pack Hardening.

As the method of pack-hardening steel has proved so satisfactory when used by the writer and also by many others who have adopted it at his suggestion, it seems wise to treat the subject at this time even though it might not be considered as belonging under the head of toolmaking.

It is a well known fact that small, thin pieces of steel can be hardened by heating red hot and dipping in oil, with little or no tendency to spring; but as steel is hardened by *rapid* cooling from a red heat and as *large* pieces of steel cool very slowly in oil, it is generally considered advisable to cool them in water, brine, or some bath which takes the heat quickly from the steel. Now it has been ascertained by experiment that steel can be treated in a manner that insures its hardening when dipped in oil, thus eliminating the danger of cracking or breaking, and reducing to the minimum the liability of springing. This is accomplished by packing the articles with some carbonaceous material in an iron box which should be covered with a flat piece of iron. The space between the edges of the box and cover should be luted with fire clay which has been mixed with water until it is of the consistency of dough. This should be allowed to dry before placing in the furnace or the rapid drying will cause it to crack. Should it crack when drying the cracks may be filled with clay and this allowed to dry.

The carbonaceous material used must not contain any elements that are injurious to tool steel. For this reason do not use *bone* in any form. Bone contains phosphorus, and this is extremely injurious, as it causes the steel to become brittle when it is in combination with carbon. Burnt bone does not contain as high a percentage of phosphorus as the raw bone, but will not give as good results as other material we can use.

If the steel used in making the tool does not contain over 1¼ per cent carbon, "charred leather" is an excellent material to use when packing in the iron box. If steels of higher carbon are used, charred leather does not act as well as charred hoofs, or a mixture of charred hoofs and horns; for charred leather has a tendency to give *high carbon* steels a grain that resembles steel made by the cementation process, when it is subjected to heat for a considerable time. But there is no such effect when charred leather is used in connection with steels that do not contain more than 1¼ per cent. carbon.

Taps are hardened by this process much more satisfactorily than when they are heated red hot and dipped in water. They are tougher, and consequently will stand more strain without breaking. Being tougher they can be left harder, which insures their holding their size longer, and as previously stated the tendency to change size and lead is reduced to the minimum. Do not attempt to pack a number of small taps in a large box, as those in the center of the box would not be in condition to harden when those near the walls of the box were sufficiently charged with carbon. Select boxes sufficiently large to hold a number of taps, yet not large enough to cause uneven heating, as it takes much longer for heat to penetrate to the center of a large box. Do not pack any work so that it is within 1½ inch of the sides, the ends or top or bottom of the box.

As the amount of heat steel receives affects it to a greater extent than is recognized by the average mechanic, it is necessary to watch these heats very closely. High heats have the effect of opening the grain of the steel, making it coarse, and in this condition it is weak. On the other hand it must be heated to a temperature that will insure its hardening when quenched in the bath. This heat should be the lowest possible consistent with results desired, and should not be higher than a low red heat.

The degree of hardness depends upon the length of time the steel is subjected to the action of heat when in contact with the carbonaceous material; and as it does not commence to absorb carbon until it is *red hot* it is necessary to time from the period the steel becomes red. In order to ascertain the time, a way must be provided for finding out when the contents of the box become properly heated *throughout;* and as the center of the box would be the portion furthest removed from the action of the heat in the furnace, we run wires down through holes in the *center* of the cover, and have them extend to the bottom of the box, and project about one inch above the cover, so that they may readily be grasped by the tongs.

When the articles have been packed in the hardening box, the cover put in place, and luted with fire clay, and test wires run down through the holes in the cover, the box is placed in the furnace. After it has been subjected to heat for a period of time which in the judgment of the operator should be sufficient to heat it throughout, reach in with a pair of long-handled tongs and remove one of the test wires. If this shows red its entire length, note the time; if it is not red its entire length, wait a few minutes, then try another. Continue doing this until a wire is drawn which denotes the uniform heating of the entire contents of the box.

The length of time to subject the work to heat after the box is heated throughout depends on the size of the taps. Small taps need not be run as long as the large ones. Taps ¼ inch diameter, if made of most any of the steels ordinarily used for this purpose, should be run from one-half to one hour; larger ones should be run proportionally longer. The condition of the material to be tapped has something to do with the degree of hardness necessary. When they have run the required length of time in the furnace, remove the box, take off the cover, and, by means of blacksmiths' tongs, grasp the taps one at a time by the shank end, and immerse in a bath of *raw linseed* oil, working the taps up and down and around in the oil.

When drawing the temper, if the necessary apparatus is at hand, we can place the taps in a kettle of oil over a fire, heating the oil until the proper temperature has been reached, which can be ascertained by means of a thermometer made for the purpose. Ordinarily if the oil is slowly heated to 460 degrees—which is equivalent to a full straw color—and allowed to remain at that temperature for a little while, the steel will have absorbed the desired amount of heat. It is not advisable to heat the oil quickly and remove the work the moment the thermometer shows the required temperature; for the steel will not take the heat as rapidly as the oil, and as a consequence will be too brittle to stand up well when in use. For some classes of work the temper must be drawn lower than the degree mentioned, say 500 degrees F.—which is equivalent to a *brown* color. However, if the taps are heated carefully to a *low* red when hardening, they may be left harder than when hardened in the ordinary manner.

If we wish to draw the temper "to color" we must brighten the walls of the flutes in order that the colors may be readily observed. If there is no emery wheel at hand the walls of the flutes may be brightened by means of a piece of emery cloth held on a file; but the utmost care must be exercised in order to avoid touching the cutting edges of the teeth, as these would be rounded, and thereby rendered unfit for use. As most shops are provided with emery wheels, however, it is seldom necessary to use emery cloth. The wheel should be dressed to the shape of the flute and sufficient stock removed from the back of the land to smooth it, so that it will not hold chips, and to polish it so that temper colors may readily be observed. Enough must be removed from the face of the land to remove the irregular effect given the face of the teeth—threads—by the action of the milling machine cutter which causes the faces to assume a convex shape; this shape seriously interferes with the cutting qualities of the tool. It is also necessary to remove enough stock to break the burr thrown between the teeth when cutting the groove.

When drawing the temper, heat slowly, or the teeth, which are lighter than the balance of the tool, will absorb heat faster and become too soft, while the body of the tap will have the appearance of being of the desired temper.

### Machine Taps.

This term is applied to taps which are intended for use in various machines, as screw machines, turret lathes, tapping

machines, etc. They differ from *hand taps* in that the lands are narrower, which is allowable on account of their shanks being firmly held in chucks, or collets, which guide the tap properly, and there is thus no tendency to press the tap to one side. As they are intended to run through the piece being tapped, which in turn is deposited on the long shank, considerable relief *between* the threads can be given them, being careful not to carry the relief to the cutting edge. But if the tap is to run into a hole, then reversed and run out, it is not well to give them much relief, since chips would be drawn into the cavity formed by the relief when backing out.

Taps of this description must be roughed to sizes somewhat larger than finish, then the shank turned to size. They may then be back-rested, the thread end turned to size and the threads cut with an off-set threading tool, which allows the operator to place the back-rest much closer to the portion being threaded than if a straight tool were used.

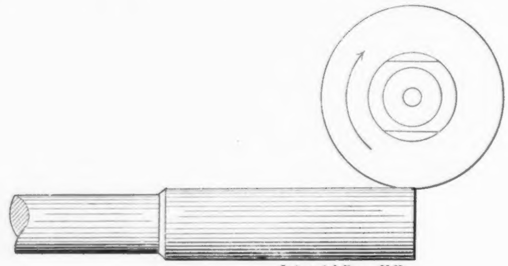



Fig. 17. Milling the Flutes of a Right-hand Tap.

When machine taps are used for tapping holes that are drilled or reamed, thus insuring round holes, four cutting edges work very nicely; but if nuts whose holes have been punched are to be tapped, better results follow if the tap is given *five* flutes. When five flutes are given a tap the lands must be somewhat narrower than when there are but four, to provide flutes large enough to hold the chips.

*Taper Taps.*—The same general directions given for making taps of other forms may be observed when making taper taps, but a few points peculiar to this form must be observed.

To have the tap correct as to pitch cut the thread on the tapered surface by means of a taper attachment, rather than by setting over the tailblock. Should we gear the lathe to cut a thread of the desired pitch, then attempt to get the taper by setting over the tail center, we would produce a finer pitch than desired; and if our taper was very pronounced we should have a staggered—drunken—thread. While this is true many taper taps *are* made and threads cut tapering on a lathe where it is necessary to set the center over to produce the desired result. If the threads are well relieved, however, they will work, and answer in an emergency; but do not use this method if a lathe having a taper attachment is available.

Set the threading tool, for cutting the thread of a taper tap, square with a line passing through the centers of the piece, rather than square with the tapered surface. This line is known as the *axis* of the piece.

Taper taps should *always* be given relief between the threads, in order that they may cut, rather than pressing the stock out of the way, as the heel of the thread will drag unless relieved.

*Left-Hand Taps.*—Left-hand taps are made the same as those having right-hand threads except that the threads are cut left-handed and the cutting faces are on opposite sides of the lands. The same milling cutter may be used in either case. These are made to give the proper shape when starting at the cutting end of tap and running against the work, as shown in Fig. 17, for a right-hand tap. When used for cutting a left-hand tap it must be reversed on the arbor, the machine run in the opposite direction and then commence at the shank end, as shown in Fig. 18. Left-hand taps should always be so stamped that there may be no confusion when picking them out. In some shops they are stamped "Left," while in most places they are simply stamped "L."

When right- and left-hand taps are used in connection with each other in making a universal holder of any description the lead of the two should be alike, and as there is no certainty that any two taps will change alike in lead, even though made from the same bar of steel and treated as nearly alike as possible when hardening, it is advisable to pack-harden them.

*Square-Threaded Taps.*—This form of tap is not used so extensively as several years ago, having been superseded in many cases by the Acme standard thread. If a full thread is to be made by the passing through of one tap of the square-threaded form, relieve the threads on the top and sides, to do away so far as possible with friction. But if a full thread is to be cut by the use of several taps, make each one a trifle larger than the one preceding it, as otherwise the amount of force necessary for tapping will be in excess of what the tap can stand and it will break. When tapping a long hole by means of several taps of increasing size difficulty is sometimes encountered from the change of lead when the taps are hardened, unless they are pack-hardened.

When possible chase the thread in the hole with an internal threading tool of the proper form, using a finish tap to size the hole. When a tap is to be used for sizing holes which have been threaded *nearly* to size it is not necessary to back them off very much.

Square threaded taps may be fluted the same as V-thread taps.

*Hobs for Screw Thread Dies.*—This style of taps differs from the forms in general use, in that they have more flutes. In some shops *hobs* are used to remove the entire stock incident to tapping the reamed hole; that is, one hob is made to do the entire job. These are made of two forms: In one case the hob is made tapering for three-quarters its threaded portion, the remaining quarter being straight to retain its size and the threading being tapering and straight as described. In the other case the threading is straight, but the outside is made tapering for about three-quarters the length of the threaded portion.

But in general the hob is simply a "sizing tap" whose flutes are made more numerous so that they may be run into the threading die after the clearance holes are made, to remove any burrs that may have been thrown into the threads.

In order that the hob may not have much work to do when sizing the holes in dies, several taps of the ordinary form are run in ahead of it. These taps should vary sufficiently in size from one another so that any difference in lead would not cause them to produce poor threads. There should also be difference enough in size between the largest of these leading taps and the hob so the hob may overcome any difference in lead, yet not enough difference to cause the hob to remove so much stock that the chips will fill the flutes, causing them to tear the tops of the threads. When hobs are to be used for tapping *solid* dies they must of course be of the exact size of the screw which the die is to cut. When they are intended for tapping *adjustable* dies they may be made a trifle larger. The exact amount cannot be arbitrarily stated but must conform to the practice in the individual shop. This matter will be considered more fully under "Screw Thread Dies."

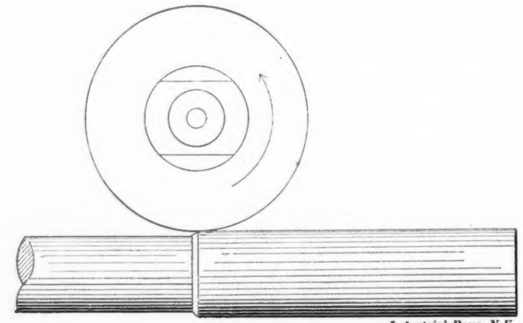



Fig. 18. Milling the Flutes of a Left-hand Tap.

In order that hobs may work satisfactorily when run into screw thread dies whose clearance holes have been made, make numerous flutes, thus providing more surface of land. The flutes should be very narrow, and the lands correspondingly broad. The number of lands provided varies from 6 to 10, according to the size of the tap—hob.

*Adjustable Taps.*—Adjustable taps are very useful where holes must be tapped to an exact size, as taps even when hardened in a manner that insures practically no change in diametrical measurements will wear in a short time sufficiently to cause them to be too small. If a tap is made of a form that allows of adjustment the size can readily be changed as it wears.

Very few taps of coarse pitch give satisfaction if made adjustable and a full thread is cut at one passage of the taps. However, they are very useful as "sizing taps," which are to be run through a hole threaded somewhat smaller than finish size.

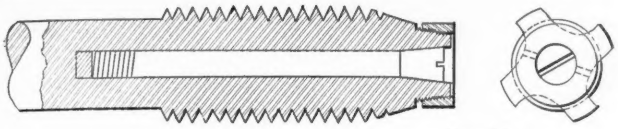


Fig. 19

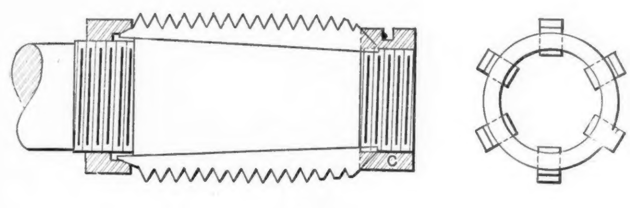
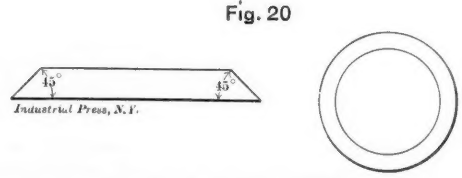



Fig. 20




Adjustable taps are made of various forms, one of the simplest being shown in Fig. 19. The size is altered by means of the adjusting screw shown. However, the various operations involved when making this form of tap are almost identical with those of making the adjustable reamer of similar form and it seems unnecessary to give them.

Adjustable taps are sometimes made having *inserted blades*, as shown in Fig. 20. This form answers nicely for *large* taps, as new blades can be inserted when the first set are worn out at a cost much less than that of making a new tap. The same general instructions given for making reamers with inserted blades will answer for this form of tap. But when milling the slots to receive the blades, cut them somewhat *ahead* of the center, as it will be found necessary to mill 1-32 inch off the cutting face of the teeth, after threading, to remove the portion where the threading tool first came in contact with the face of blades; otherwise the cut would be a trifle deeper at this point and would cause the tap to bind when in use. The face should be milled away sufficiently to make it radial—on a line with the center.

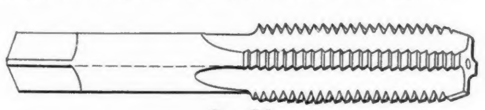


Fig. 21

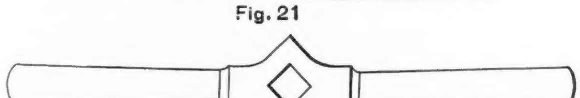



Fig. 22

The threads may be cut sufficiently to make the tap a few thousandths of an inch small. After the blades are hardened they may be placed in position and adjusted to size. The threads having been cut a trifle smaller than finish size give the lands clearance when the tap is adjusted to size.

*Tap Wrenches.*—To get good results when using a tap it must be held in a satisfactory form of holder. Taps which are actuated by hand, as hand taps, are held in tap wrenches. Suitable wrenches for hand taps must be provided. If a small wrench is used on a large tap the operator is obliged to exert so much force that he soon becomes tired. Then again under such circumstances the operator, instead of applying steady pressure, gives the wrench a succession of "jerks" which have a tendency to break the tap. If too large a wrench is used the operator must be skillful or he will apply more force than he is aware of and will break the tap. Taps are expensive tools and wrenches suitable for them should always be used.

Mill the squares on the wrench end of a hand tap so as to have the corners come on a line with the lands, as shown in Fig. 21; or rather, mill the flutes so the lands will line with the corners of the squares. It is best to mill the squares before threading the tap and cutting the flutes. This is done so that any sideward pressure occasioned by unequal pressure on the handles of the wrench will be compensated for, in a measure, by the land which would support the tap when in the work. Knowing this we make the tap wrench with the corners of the opening to receive the square of the tap, on a line with the handles, as shown in Fig. 22.

Several forms of tap wrenches are for sale. These can be purchased at figures far below the cost of making a single wrench in the shop not equipped for this class of work.

*Releasing Tap Holders.*—When taps are to be used in turret lathes, or screw machines, they are held in releasing tap holders, by the use of which the tap may be run nearly to the bottom of a drilled hole, or to any desired depth. When it reaches the proper depth the portion holding the tap is automatically released and revolves with the work until the motion of the tap or the machine is reversed, when it again engages with the shank of the holder and the tap is backed out of the work. There are many forms of releasing tap holders. We will consider but one form, that shown in Fig. 23. This is simple and easily made and gives the best of satisfaction when used.

Tools of this character are often made from tool steel. This, of course, answers very nicely, but unless a low grade article is used they are quite costly. A good grade of machine

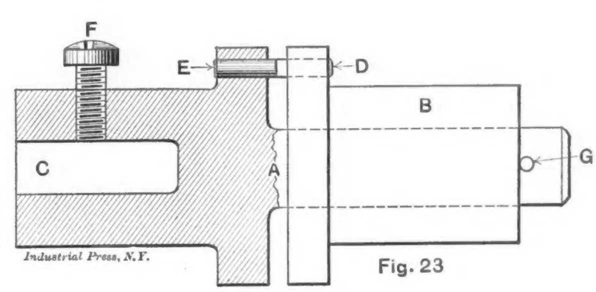



Fig. 23

Fig. 24

steel, containing 40 or 50 points carbon, answers the purpose as well, will last as long, is sufficiently stiff to resist the strain, and the cost of material is much less. When making the sleeve, *B*, a hole is drilled and reamed the entire length, as shown. This hole must be the size of the tang of the holder, as this tang is to fit in it. The reamed hole must be straight and of a uniform size its entire length. After reaming the hole to size the piece is placed on a mandrel, preparatory to turning to size. Long pieces of work should not be placed on a mandrel having much taper, as the hole being straight would get a bearing only at one end on the mandrel; the other being loose on mandrel, the hole at this end would not be concentric with the turned portion. For work of this class use a mandrel having very little, if any, taper. If no such mandrel is at hand, one can be made at a little expense, simply turning a piece of steel so it can be forced into the sleeve sufficiently tight to hold it while turning. Such a mandrel, however, will not answer for permanent equipment; the center being soft soon wears, and there is the liability of its getting out of shape. However, if care is exercised a soft mandrel will answer very nicely for one piece.

Unless the sleeve is to be fitted to the hole in the turret by means of grinding, the head (live) center of the engine lathe

should be trued before taking the finish cuts, as any eccentricity of the hole in sleeve causes imperfect alignment, and the tools and work must align as nearly correct as possible.

The tap holder, *A*, should be turned to size and fitted to the sleeve, and the large end also turned to dimensions, after which it should be back-rested in the lathe and hole *C* drilled and bored to size. Before strapping the back end of holder to the head or live center, make sure that the center runs true. It might appear to the experienced journeyman that too much stress is laid on this, but an experience of years in instructing apprentices and students has convinced me that too little attention is given this all-important point. Centers in poor condition, and dirt on centers, or in center holes, are responsible for thousands of spoiled jobs.

The hole for pin *D* is now drilled and reamed to receive the pin. After drilling and before reaming, transfer through this hole for the hole for pin *E*, in tap holder, which is reamed with the same reamer. The pins may be made from drill rod hardened and drawn to a blue color, then forced to place. Then the hole for set screw *F* may be drilled and tapped.

Now drill the pin hole in the stem of holder as shown at *G*. This pin should be so located that it will strike the end of sleeve just as the pins *D* and *E* are disengaged. When the motion of the screw machine is reversed the pins will engage with each other and the tap be backed out of the work.

In order to accommodate taps having shanks of various sizes, bushings of the form shown in Fig. 24 may be made. The holes should be a nice fit on the shank of the tap, while the outside should fit the hole in the holder.

* * *

## TALK ON LATHE SPINDLES.

F. EMERSON.

The spindle of the engine lathe has passed through an interesting evolution. The pole lathe in general use at the beginning of the nineteenth century had no rotating spindle. The work was mounted on pointed stationary centers and rotated first forward then backward by a cord wound once or twice around it. One end of the cord was attached to a springy pole or lath (hence the name lathe) overhead and the other to the workman's foot, or to a rude treadle.

While the pole lathe was a most primitive machine, the lathes used by the ancient Egyptians were still more primitive. The motive power of these crude tools was furnished by a helper who rotated the work on centers by a cord wound around it, the ends of which were held in each hand and alternately pulled. The pole lathe was thus a decided improvement on the first primitive lathes, as it dispensed with the helper and made it possible for the workman to both turn the work and operate the cutting tools. But the work was turned in an intermittent manner which made the use of tools on it difficult and unsatisfactory. The logical development of the lathe produced the rotating spindle.

The first rotating spindles were made from square iron bars. They were turned down only a short distance for the head bearing. The tail end of the spindle was supported by a pointed setscrew bearing in a cupped center. A grooved pulley of one step was mounted on the square spindle and driven by a belt from a wheel of larger diameter mounted on a shaft. The belts or bands were made from catgut. It appears to have been the practice at first to place the wheel at one side, a helper turning it by a crank. Then followed the drive wheel with crank and treadle placed below the spindle so as to make the machine operative by the workman himself.

The use of the pointed setscrew for the tail bearing served two purposes. It supported the spindle on a pivot bearing which gave the least friction, and it made a convenient means of adjustment for end wear. The end wear of the spindle against the sides of the head box seems to have been the source of considerable trouble. One early amateur who has written on the subject lugubriously complains of the burring or rumbling sound made by the square corners of his lathe spindle, grinding into the side of the box. Collars were found to overcome this fault, but for good reasons were not at first generally adopted. The necessity of cutting screws complicated the spindle problem and brought forth features which now seem grotesquely absurd.

The possibility of cutting screws in the lathe seems to have been understood at a very early date. Many schemes were devised for the purpose, among which was the most popular one at one time of moving the spindle longitudinally in its bearing. By having a screw cut on the spindle and engaging a wooden half-nut with it, the spindle would move longitudinally as it turned and generate a screw of the same pitch on the work held in a chuck as it passed before the point of a stationary tool. During screw cutting the setscrew supporting the tail end of the spindle was backed away to give it free longitudinal motion. The spindle was then only supported by the head bearing and the wooden half-nut bearing on the under side. Little less than the patience of Job was required to make screws by this jiggley arrangement, but they were made in a passable manner, which is an indication of the patience and skill of the early artisans.

Bearing this in mind it is quite apparent that the use of screws as "stitches" for uniting the parts of machines was greatly hampered in the early days by lack of suitable means for cutting threads. But the demand for these indispensable parts was so insistent that the lathe must be developed so as to make them in a more rapid and satisfactory way. Hence the invention, attributed to Maudslay, of the screw-cutting lathe having a leadscrew connected to the spindle by change gears. But the pointed setscrew bearing was retained long after this time because of its adjustability and little frictional resistance to driving. It must be remembered that few lathes were driven by power in the first years of the nineteenth century; almost all of them were worked by foot power, and the matter of friction was a serious one. As lathes developed in size, however, the pointed setscrew bearing was finally

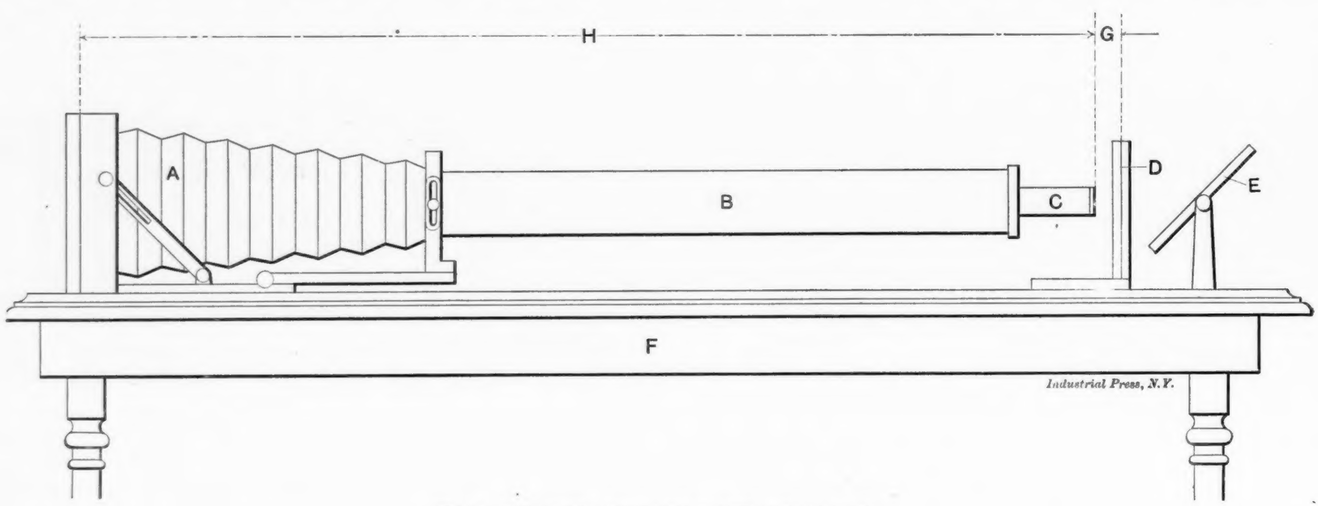



Fig. 1. Homemade Apparatus for Microphotography.

abandoned for a small diameter cylindrical bearing at the end of the spindle, which feature is still retained in modern lathes, for good reasons—perhaps.

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In the primitive lathe the conical point or center was made solid with the spindle. Removable centers were first made to screw into a hole bored in the end of the spindle, and this threaded hole was also employed for fixing chucks, the chucks and faceplates being made with threaded shanks or spindles instead of the threaded socket commonly used now. The extension of this hole through the spindle to make the hollow spindle is probably due to chance rather than design, although the desirability of such a construction was, no doubt, appreciated by early mechanics; the difficulty of boring a hole through the spindle must naturally have prevented its being done. But when some gunsmith set out to make a lathe for his own use he would quite naturally have selected an old musket barrel for the spindle, and in that he had a hollow spindle as good as though made to order. His lathe was the pattern for others, and so this idea and others slowly spread—how slowly is quite difficult for us to appreciate now.

* * *

## MICROPHOTOGRAPHY.

W. H. SARGENT.

There is a feeling among many people that while microphotography is an interesting, agreeable and instructive art, yet that it requires expensive apparatus and is difficult of operation. This is doubtless true where enlargements of extremely high magnification are to be made, as when bacteria are to be photographed to a scale of 1,000 diameters, which is the standard for this class of work. But I have been making some interesting experiments with a cheap home-made outfit, examining some of the commonplace objects which are to be found every day in the shop, and enlarging them, although not to a very large scale and have been quite successful.

My apparatus is shown in Fig. 1, *A* being an ordinary 4 x 5 camera with the lens removed and in its place a piece of pasteboard mailing tube *B* about 20 inches long. At the end of this tube is the lens *C*. This was the subject of many experiments. The ordinary camera lens at this point magnifies about six times; the lens from a pocket kodak, about 10 times;

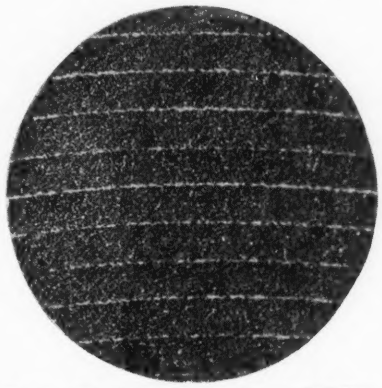


Fig 2. Spiral Circle Emery Paper—Full Size.

Fig. 3. Spiral Circle Emery Paper, Magnified 100 Diameters.

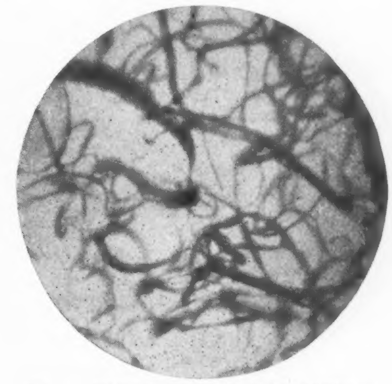


Fig. 4 Chips Removed by Spiral Circle x 100 Diameters.

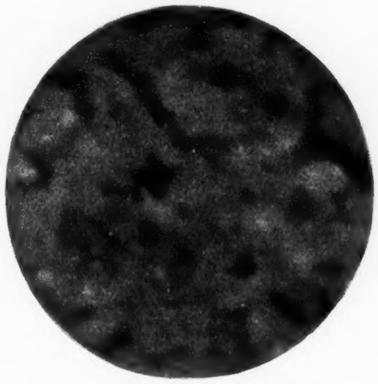


Fig. 5. Sandpaper x 100 Diameters.

Fig. 6. Antimony x 10 Diameters.

Fig. 7. Carborundum x 100 Diameters.

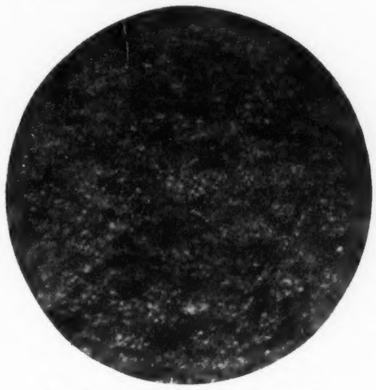


Fig. 8. Cast Iron x 10 Diameters.

Fig. 9. End View Wrought Iron x 10 Diameters. Broken at 70,600 lbs. per square inch.

Fig. 10. Side View (Wrought Iron x 10) of same piece broken in Testing Machine.

and the eyepiece from an ordinary telescope, about 100 times. By "times" is meant diameters, and the amount of magnification may be found by dividing *H* by *G*, the same as the multiplication of a lever may be found by dividing the long arm by the short arm. The shorter the fulcrum distance the more the lever multiplies; the shorter the focus of the lens the more the camera magnifies. I have tried lenses from surveyors' levels and transits with surprisingly good results, considering that these lenses were not designed for photographic work and that the chemical and visual rays were not corrected to focus at the same point. The object to be photographed was held between two glass plates *D*, and if it was transparent a mirror *E* was placed behind so as to throw the light through

the subject onto the lens. If opaque, the mirror was placed at one side so as to throw the light on to the front of the object. In all cases a bright light was found necessary, since the light coming on one square inch would, if we were magnifying 10 times, be distributed over 10 x 10 or 100 square inches. Soft sunlight was found the best; lamplight would not answer at all. Ordinary photographic plates were used and the time required was from two to four minutes. Great care was required in focusing, a grain of emery appearing so large that it was difficult to get the top and bottom in focus at the same time. It was also necessary to fasten the outfit to the table to prevent vibrations which would of course be magnified in the same ratio as the object.

* * *

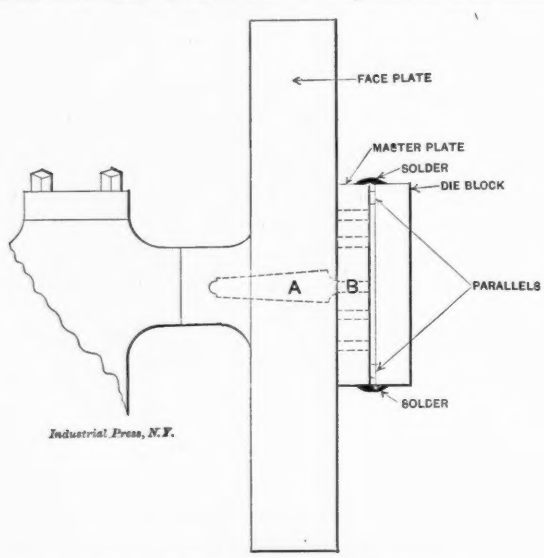
## A FEW SUGGESTIONS IN TOOL-MAKING.

FRANK E. SHAILOR.

Frank E. Shailor.

Oftentimes the output of a factory necessitates fou<sup></sup>r or five jigs or dies that must be exactly alike. Now to make a number of jigs and dies that will perfectly interchange is no mean job. The very best method that has come under the writer's notice for exactly duplicating any number of jigs or dies is the use of the "master-plate."

The master-plate is made either of cast iron or machinery steel and contains the same number of holes, in the same relative position, as are to be in the jig or die. Into these holes are forced hardened steel bushings that have been lapped to a given size and ground outside concentric with the holes. In making the master-plate the greatest possible care should be exercised in making same as accurately as is possible. Further, if the jig is to produce exceedingly accurate work, the master-plate should be made of steel that has been thoroughly "aged." Brown & Sharpe Mfg. Co. state that it requires about eight years for a piece of steel to thoroughly age, or settle, of its own accord. But, it has been found that by removing all scale and placing the steel on the base of an electrical generator, which subjects the steel to constant vibration and ever-changing temperature the steel will age in about six weeks time. Another way of aging steel frequently used, is the "hot and cold water" method. The steel so treated is first worked to within 0.01 inch of the finished size, and is then immersed



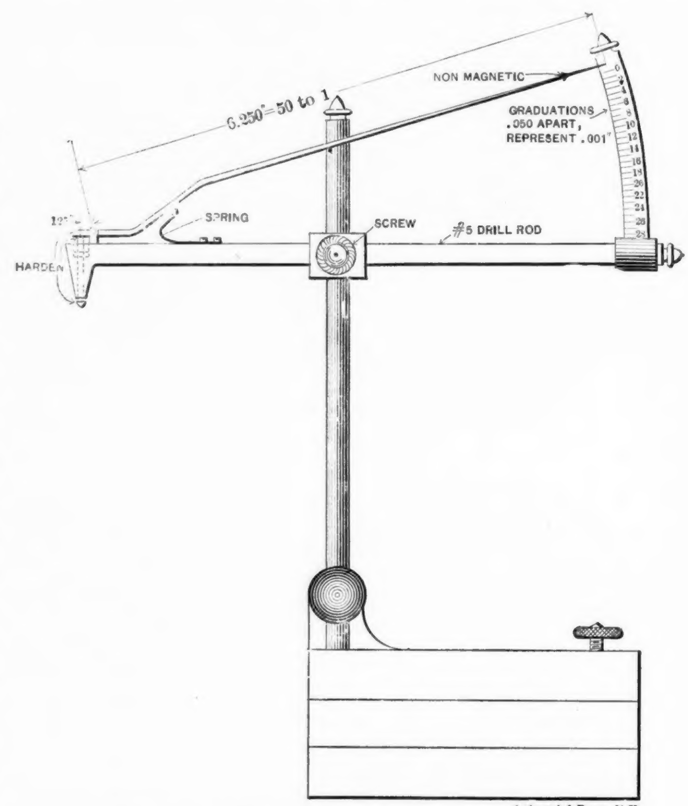

*Industrial Press, N.Y.*

**Fig. 1. Making a Die from a Master-plate.**

in a bath of boiling water which causes it to expand. Then it is dipped into ice water to cool it. This operation is repeated perhaps one hundred times, and the repeated expansions and contractions cause the molecules to settle into permanent form. Using this precaution of aging the steel obviates the danger of the master-plate changing form after same is finished.

To return, let us assume that the master-plate is completed and is as nearly accurate as it can be made; we may even grant that a slight personal error has crept in caused by uneven tension on micrometer screw, when measuring, but if the error is so slight that it will not materially affect the finished product, and the master-plate is adopted as the shop standard and all jigs and dies are made from the master-plate it is evident to all that the jigs and dies will contain that slight error also. But each jig or die will be an exact duplicate, and interchangeable. To make a die or jig from the master-plate is as follows:

Select a lathe with perfect bearings and carefully face off the faceplate. Do this only on the lathe where it is to be used and do not disturb the faceplate until all the work on the jigs is finished. Next a center, *A*, Fig. 1, is made of machinery




*Industrial Press, N.Y.*

**Fig. 2. Multiplying Gage or Indicator for General Work.**

steel to fit the taper in the spindle of the lathe, and to project beyond the face-plate plus the thickness of the master-plate. The end, *B*, of the center is then carefully turned (not filed) to closely fit the holes in the master-plate. The die block is then fastened to the master-plate by means of a small amount of solder at each end—the die block separated from the faceplate by thin parallels, as shown. Starting at hole No. 1 the master-plate is wrung on the center until the master-plate rests firmly against faceplate, in which position it is securely clamped. The die block is then spotted, drilled and bored. It needs no further argument to convince the reader that the hole in the die block is directly opposite the hole in the master-plate. By repeating the above operation until all the holes are bored in the die block the master-plate can then be laid away until called upon to duplicate a die or jig. The same method is applicable to numerous other jobs, such as fastening the punch holder to the die and using the die as a master-plate to transfer the holes into the punch holder, etc.

### Gages, Hand Reamers and Arbors.

To insure a plug or ring gage, hand reamer, or arbor remaining true and to size it is necessary to work the article to within say 0.01 inch of finished size, harden, and age same by placing it where it will be constantly jostled about (preferably on the base of an electrical generator) for at least six weeks' time before finishing. Undoubtedly a great many readers will say that this extra precaution is unnecessary, but when a piece of steel is hardened there are internal strains set up, and if said strains are not entirely removed the finished gage will be anything but satisfactory. Only those who have had experience making gages know the poor results obtained by making a plug and ring gage from an unsettled bar of steel. All arbors, ream-

ers, gages, etc., turned out by standard tool-making concerns are thoroughly treated in above manner. The warranted surface plates manufactured by Brown & Sharpe Mfg. Co. are eight years old before they leave the factory. The above is cited merely to show that it is necessary to "age" steel if a gage is to remain a standard.

### Grinding and Lapping.

When making gages, reamers, spindles, or any tool that has to be ground, it is better to leave considerable stock to be ground off than to finish within say, 0.005 inch and be obliged

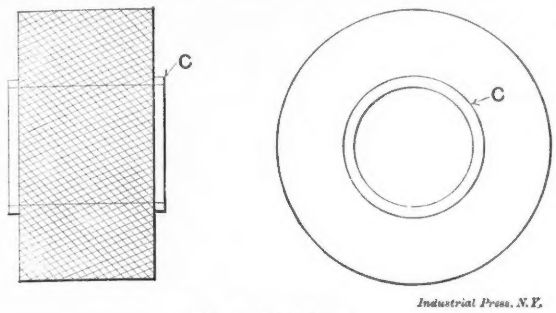



Fig. 3. Ring Gage.

to pene the tool in order to straighten it sufficiently to "clean up." It is possible to pene a piece of steel that has sprung in hardening so that it will run true, but pening simply compresses the stock where pened, making that part stiffer and holding a set in the steel so that it runs true; but just as soon as the least bit is ground off, the pening loses that much of its effect and the steel partly returns to its bent form. Therefore it is better to make a larger allowance for grinding than a small allowance for pening.

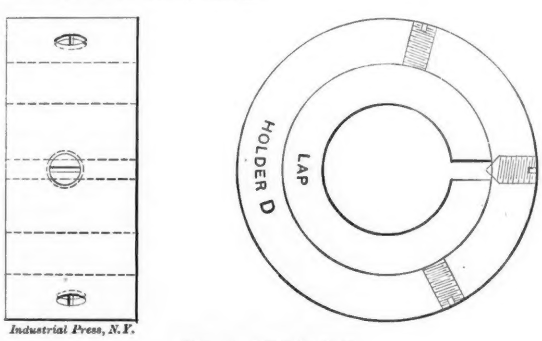



Fig. 4. Outside Lap.

The emery wheel receives less attention than is necessary to produce good work. It is a mistaken idea among some toolmakers that to obtain a nice smooth surface it requires a very fine wheel. A fine-grained wheel glazes very quickly and then bounds along on the work, cutting only here and there, altogether leaving a very untrue and rough surface. On the other hand a coarse wheel (that runs fast enough) will cut freely and smoothly, owing to the keener cutting points and more numerous and larger recesses for debris to gather without impairing the cutting points in the least. Satisfactory results are sometimes obtained by using water on a fine wheel; but very seldom when run dry. Different diameters and surfaces require different allowances for grinding. A 1-inch plug gage that has a good smooth surface needs only about 0.0015 inch for lapping.

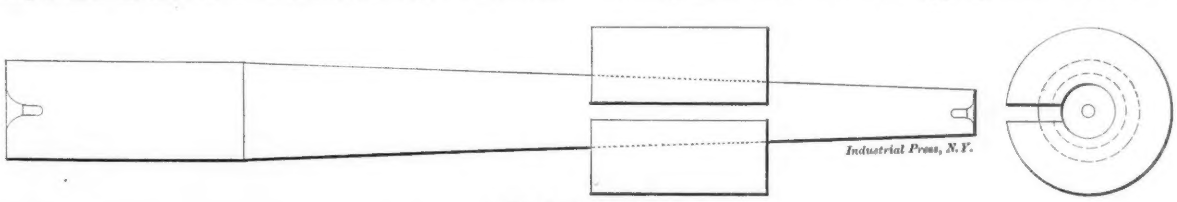



Fig. 5. Inside Lap

The outside lap, shown at Fig. 4, should be made of cast iron, copper or lead, and the holder *D* should be provided with adjusting screws. The flour emery used should be sifted through a cloth bag to prevent any large particles of emery entering the lap and scratching the gage. After sifting the emery it is mixed with lard or sperm oil to the consistency of a thin paste. The gage is then gripped in the chuck of the lathe by the knurled end and smeared with emery paste. The lap is adjusted to fit snugly on gage and the lathe is speeded up as fast as possible without causing the emery to leave the gage. The lap requires constant adjusting, to take up the wear of the lap, and reduction in size of the gage. When measuring the gage it should be measured at both ends and in the center to make sure that it is not being lapped tapering. When the gage has been lapped to within 0.0002 inch of finished size, allow the gage to thoroughly cool and then by hand lay lengthwise of gage to the finished size. By so doing all minute ridges that are caused by circular lapping are removed, thereby leaving a true surface and also imparting a silvery finish. A gage should never be lapped to size while warm (caused by friction of lap), because the gage expands when heated and if lapped to size it will contract enough to spoil it.

In grinding out the inside of a ring gage considerable difficulty is experienced in adjusting the grinder so that same will grind straight. One way to prove the straightness of a hole being ground is to move the wheel over to the opposite side of the hole until wheel will just barely "spark." Then, beginning from the back of hole, feed out, and if the hole is tapering the wheel will either cease to spark, or will spark considerably more. Another and better way is by means of the multiplying indicator gage, Fig. 6. By fastening the indicator to the spin-

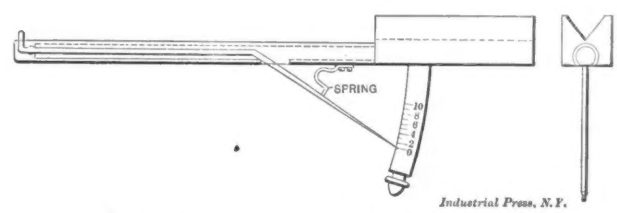



Fig. 6. Multiplying Gage for Testing Holes for Parallelism.

dle of the grinder and placing the contact pin of indicator on the opposite side of the hole and feeding in and out, the pointer will record in thousandths of an inch just what the deflection is.

A ring gage should be made as shown at Fig. 3, the object being to prevent the gage becoming "bell muzzled" while lapping. After gage is finished the thin projecting web *C* is ground off, leaving a good straight hole. The lap used for inside work is shown at Fig. 5. The lap can be made to always fit the gage by merely forcing the lap further along on the taper arbor. The lap being slotted allows same to expand. In making a ring gage having a taper hole or a taper plug gage, it is necessary to employ a different method for lapping, as it is impossible to lap a taper hole with a taper lap. The facts regarding lapping are these: First, the lap must fit the hole at all times, secondly, the lap must constantly be moved back and forth. Therefore, if a taper lap is made to fit the taper hole it will lock and not revolve. If held in one place the lap will quickly assume the uneven surface of the hole. If the operator attempts to lap a taper hole by constantly revolving the gage on a straight lap he will surely dwell longer in one place than another, thereby making a hole that is anything but round. The writer suggests the following method: Having ground the hole to size, plus allowance for lapping, and without disturbing position of slide rest or grinder head, change the emery wheel for a lap made of copper—same shape as emery wheel with the exception of having a wider face—and lap in same manner as hole was ground, care being taken not to "crowd" the lap.

* * *

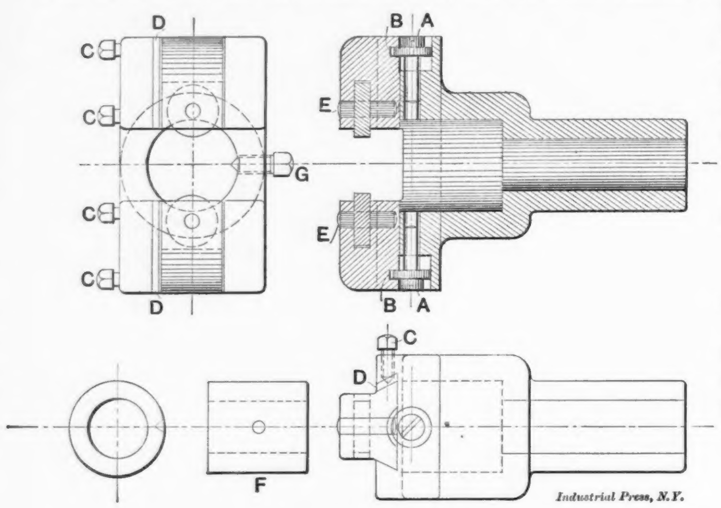
Plans for a model foundry, to be carried on in connection with the St. Louis Exposition next summer, by the Worcester Polytechnic Institute, are now completed and it is expected that the construction of the building for that purpose will begin very soon. The entire charge of the foundry throughout the summer will be in the hands of the Institute.

# LETTERS UPON PRACTICAL SUBJECTS.

## KNURLING TOOL FOR TURRET LATHE.

*Editor* MACHINERY:

The accompanying drawing shows an adjustable knurling tool for the turret lathe. I have found this tool very useful, and I send it in the hope that it may interest some of your readers. The head of the holder has a slideway planed across it, into which the mild steel blocks carrying the knurls slide. They are adjusted to and from the center by means of the screws *A A*. The collars on the screws fit into the notches *B B* in the blocks. After the blocks carrying the knurls have been adjusted to the required size, they are locked in position




Adjustable Knurling Tool.

by means of the screws *C C C C* pressing on the strips *D D*. The pins *E E* on which the knurls run are made of tool steel and should be hardened and ground. The large hole in the body of the holder is to enable work of large diameter to be knurled. The hardened and ground bushing *F* fits the large hole and is held in position by the screw *G*. This bushing is used when the work being knurled requires supporting, which is sometimes necessary. The tool being adjustable enables the knurls when they become worn to be softened and recut, which, of course, could not be done without losing the size if the tool was not adjustable. CHERRY RED.

## PIPE JOINTS FOR SUPERHEATED STEAM.

*Editor* MACHINERY:

As superheated steam has come to stay, suggestions as to how it can be best conducted from superheater to engine, are timely; for owing to its high temperature, equivalent in

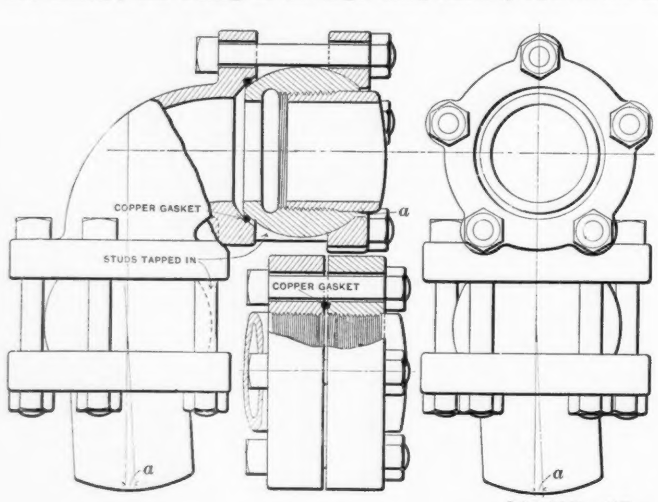



Fig. 1. Fig. 3. Fig. 2.

some instances to iron at a cherry red, all soft joint and rod packings must go. Then, too, its high temperature has multiplied the expansion and contraction of all the parts it touches. With saturated steam, the changes in shape due to differences in temperature, were allowed to take care of themselves, but when using highly superheated steam, this cannot be done, and flexible piping from superheater to engine at least is a necessity.

In the illustration, Figs. 1 and 2 are of an elbow with a ball and socket joint, with a copper wire gasket let into the elbow. The ball should be surface hardened and ground true and smooth, so that the slight movement between the surfaces of ball and gasket will not abrade either. It will be noted that the pipe, in the sectional part of Fig. 1, is screwed into the ball as far as the shouldered end of the thread will allow, which leaves the pipe about as strong as though no thread had been cut on it. The distance *a* shows the limit of flexibility of the joint. This elbow, owing to its swivelling nature, makes an expansion joint in the line, in as many directions as are needed to relieve the pipe of extraneous strain. Fig. 3 is a flange union with a copper wire gasket let into each flange.

For the elbow, it is recommended to paint the ball occasionally with black lead. AMOS PRICE.

## WRIST-PIN TURNING MACHINE.

*Editor* MACHINERY:

Many times in my past experience I have wished for something better than the ordinary engine lathe for turning the wrist-pins of crossheads. An opportunity finally was afforded me to devise something for doing this work, and a machine

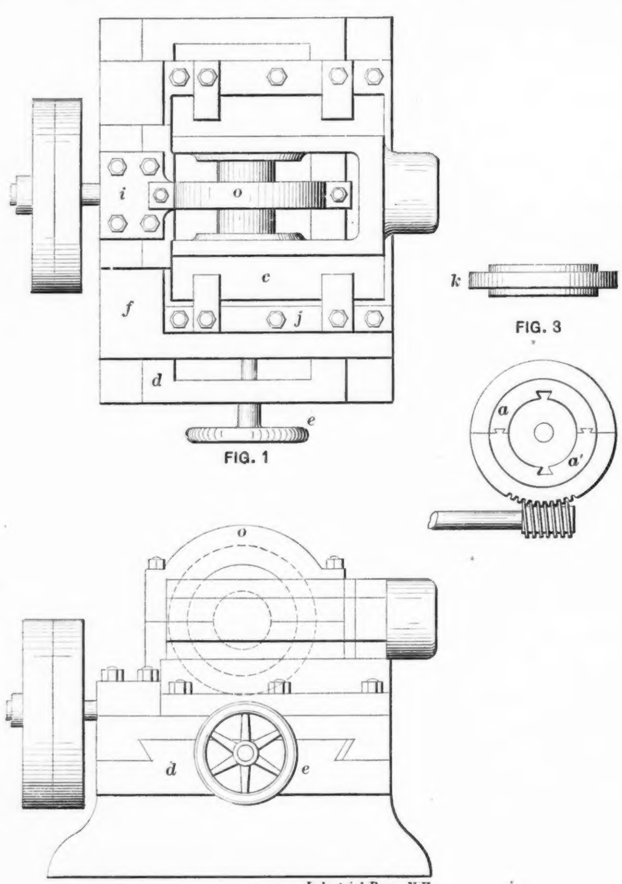



FIG. 2 Industrial Press, N.Y.

Wrist-pin Turning Machine.

was built. Since then I find many others have been thinking along the same lines, and wrist-pin turning devices in varied forms have been the result. It may be of interest to those who propose wrestling with this problem, as well as those who have produced machines, to see a description of the one I designed, and to such the accompanying drawings will be sufficiently well understood without any lengthy description of same.

Fig. 1 is a plan of the machine and Fig. 2 is a side elevation. Fig. 3 shows the annular cutter ring with its worm driving shaft. This ring, of course, must be made in halves, and is

held together by dovetails, as shown at *a a'*. The dovetailed slots on the inside of this ring are for holding turning tools. This ring is fitted neatly to the casing *o*, Figs. 1 and 2. This casing is securely attached to the platen *d* at *i*, and the crosshead, being mounted on the carriage *f*, is moved from side to side by the hand wheel *e* during the process of turning. The crosshead is planed before coming to this machine, so that by means of a suitable jig, *j*, it is readily placed squarely with the planed surfaces.

It is apparent that the scope of such a machine must be limited to a few sizes of crossheads. With the conditions met with in the larger classes of steam engines, an entirely different construction is necessary. For example, in the works of Mackintosh, Hemphill & Co., Pittsburg, Pa., three such machines are in use, with capacities for turning wrist-pins, or journals, ranging from 10 to 24 inches diameter. The design of these machines is their own, and they are admirably adapted to the work they have to do. QUIRK.

## FRACTIONAL THREAD CUTTING AND COMPOUNDING.

*Editor* MACHINERY:

After reading Mr. F. H. Colvin's article in the November number, I was asked by a shopmate to explain some points in it that he failed to understand, and after thinking it over I thought I would "butt in" on the subject in MACHINERY.

Now in cutting fractional threads with 3 or 5 lead screw it is not so easy to figure out the gears, so why not try another way, and that is, carry out any fractional pitch to whole turns in whole inches. Thus in a screw thread ¾-inch pitch there are 4 turns in 3 inches; then with a lead screw of 3 pitch we have 9 threads in 3 inches. So we can put it down like this:

$$\frac{9 = \text{number of threads in 3 inches of lead screw}}{4 = \text{number of threads in 3 inches of the work}}$$

We can multiply both by any number to get the gears, say 6. Then we have as follows:

$$\frac{9}{4}\times\frac{6 = 54 \text{ the driver}}{6 = 24 \text{ the driven}}$$

A lead of 13-16 inch is just as easy, as we can see that it is equivalent to 16 turns in 13 inches, and in 13 inches of the 3 lead screw there are 39 turns. On putting it down as before we have:

$$\frac{\text{Threads in 13 inches of lead screw } 39}{\text{Threads in 13 inches of the work } 16}\times\frac{2 = 78 \text{ driver}}{2 = 32 \text{ driven}}$$

So when we get a thread of 1 7-16 inch lead to cut we can carry it to full turns in whole inches. Then we find it is 16 threads in 23 inches and in 23 inches of the 3 lead screw there are 69 turns. So we can proceed as before and we have as follows:

$$\frac{69}{16}\times\frac{2 = 138 \text{ driver}}{2 = 32 \text{ driven}}$$

If we do not have a gear as large as 138 we shall have to compound.

Again, in cutting a thread of ¾ turn in one inch we see it is 1½ turns in 2 inches and 3 turns in 4 inches of the work. Then in 4 inches of a 3 lead screw there are 12 threads, so we put it down as before and multiply by any number, say 8. Then we have

$$\frac{12}{3}\times\frac{8 = 96 \text{ driver}}{8 = 24 \text{ driven}}$$

By this method of finding the gears we do away with fractions and the necessity of finding the common denominator. All we have to do is find the least number of inches that contain whole threads, and find how many turns the lead screw contains in that many inches. Then select our gears in the same proportion. The gear in proportion to the lead screw goes on the stud and the gear in proportion to the thread on the work goes on the lead screw.

About five years ago I saw an article on the compounding of gears in MACHINERY that was very simple and easy to handle. We first put down pitch of the lead screw, and under it in the form of a fraction the number of the thread we have to cut, thus:

$$\frac{4 \text{ pitch of lead screw}}{18 \text{ pitch of thread to be cut}}$$

Then find two numbers which, multiplied one into the other, will equal the lead screw, and do the same with the number of the thread to be cut, thus:

$$\frac{4 = 2\times 2}{18 = 3\times 6} \text{ or } \frac{2\times 2 \text{ drivers}}{2\times 9 \text{ driven}}$$

We can multiply all round by the same number if convenient, or, if not, either pair may be multiplied by any number, and the other pair by any other number. (By a pair I mean a driver and a driven.) We multiply first by 10. Then we try the other by any two numbers, thus:

$$\frac{4 = 20\times 20}{18 = 30\times 60} \text{ or } \frac{2}{2}\times\frac{12 = 24}{12 = 24} \text{ and } \frac{2}{9}\times\frac{8 = 16}{8 = 72}$$

In the second example we have a driver and a driven the same. So we double up the driven and the other driver. Then we have it like this:

$$\frac{24}{48}\quad\frac{32 \text{ drivers}}{72 \text{ driven}}$$

But if it happens that we have a 3 lead screw instead of a 4 lead screw we can put it down like this:

$$\frac{3 = 3\times 1}{18 = 2\times 9} \text{ from whence}$$

$$\frac{3}{2}\times\frac{12 = 36}{12 = 24} \text{ and } \frac{1}{9}\times\frac{10 = 10 \text{ drivers}}{10 = 90 \text{ driven}}$$

But we have not got a 10 gear, so we proceed as follows: Multiply the 10 and 24 tooth gears by 3, which gives the following:

$$\frac{36}{24\times 3 = 72} \text{ and } \frac{10\times 3 = 30 \text{ drivers}}{90 \text{ driven}}$$

We now have a pair of gears in the proportion of 1 to 2 and the other pair as 1 to 3. If we do not have the gears called for in the trial we can note the proportion between any driver and driven, and select accordingly.

Elmira, N. Y. JOHN A. BURGESS.

## GRADUATING CROSS-FEED SCREWS.

M. H. Ball.

*Editor* MACHINERY:

The accompanying cuts show ways of graduating the cross-feed screws of lathes or the feed screws of planers, shapers, milling machines, etc. This is not offered as a substitute for a tool that is already graduated, but as a simple way by which it may be accomplished on a tool that is without graduating screws.

The collars shown at *A* and *B*, Fig. 1, next page, are very convenient, as the lines show very distinctly at the position the operator is likely to be in when making adjustments, and I think in most cases it is well to follow this design, although the graduating can be and is sometimes put on the outside of a straight-faced collar and face of slide casting against which the collar rests.

Fig. 3 shows the tool for doing the spacing. It consists of a disk (a small section of which is shown) of sheet iron of not less than 12 inches in diameter (larger is better) with a hole in the center to fit over the hub of the collar on the screw. On the disk is a circle accurately spaced off to the required graduations, and a pointer *D* fitting closely over the screw *S*, with its point *E* and marking edge *F* thinned down, as shown, to assist in accurate setting and marking. The marking can be done very satisfactorily with a scratch awl. If other shaped collars are used the pointer must be shaped at *F* to conform to their shape.

Fig. 1 shows a collar for a four-pitch screw graduated in

sixty-fourths and thousandths. The collar *A*, which is fast to the screw is graduated in sixty-fourths, and the collar *B*, which is fast to or a part of the slide is graduated in thousandths for a distance of one of the sixty-fourth spaces.

Fig. 2 shows a six-pitch screw graduated in the same way, but this, of course, does not come out even like the four-pitch

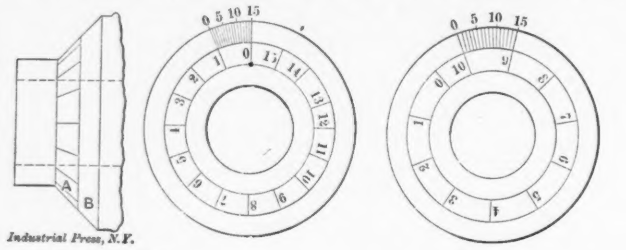



Fig. 1. Fig. 2.

screw, and, as will be noticed, the space between 0 and 10 is shorter than the rest. Still this comes very handy for small adjustments.

The unequal divisions in Fig. 2 vary so much from the rest that I think it is not likely to be the cause of a mistake being madė by the difference not being noticed, and in regard to a mistake being made by an error in reckoning, I think that this is not very likely to occur on account of the graduations being used mostly for *small adjustments*. If large adjust-

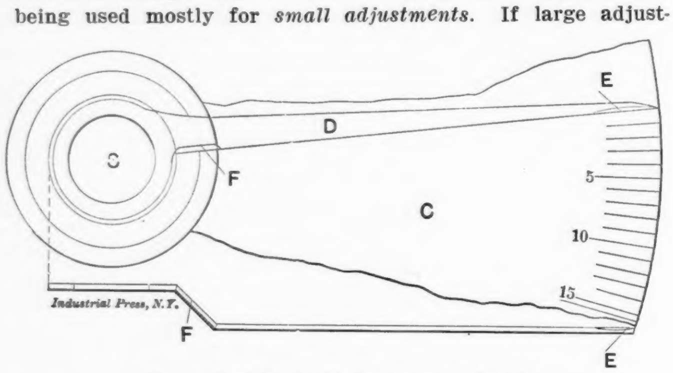



Fig. 3. Tool for Graduating Cross-feed Dials.

ments are wanted (unless they run in half or even inches) I must confess this to be rather perplexing, but have used this with very satisfactory results and have not found anything better for a six-pitch screw. Of course, the four-pitch is the ideal screw to graduate in this way, but I would much rather have the graduated screw than the plain, whatever the pitch. M. H. BALL.

Watervliet.

## TURRET LATHE TOOLS.

*Editor* MACHINERY:

A remark made to me by a pattern maker, to the effect that in his thirty years' experience he had never seen a similar tool before, is the reason for describing such a well-known tool as the undercut (forming) tool here illustrated.

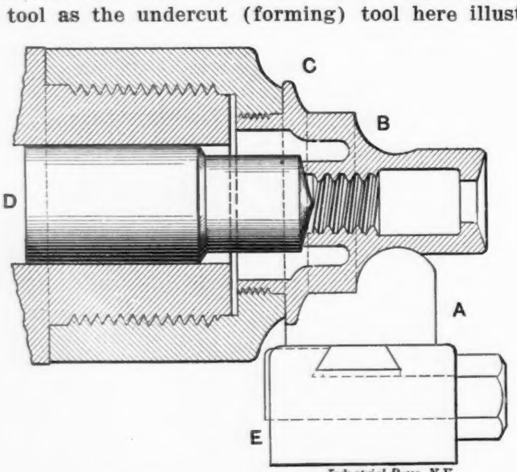
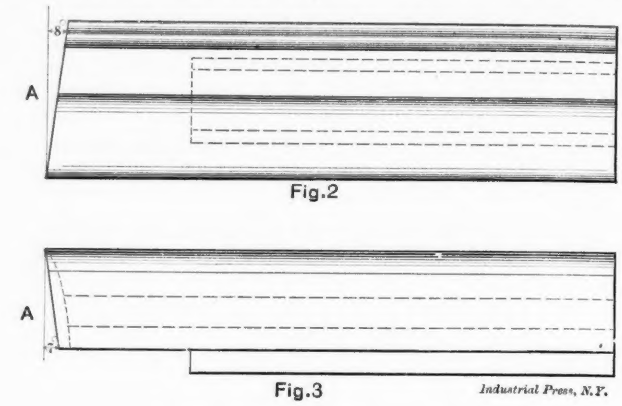



Fig. 1. Chuck and Forming Tool.

The function of this tool is the forming and finishing of the bonnet of the ordinary steam valve, a cross-section of which is seen in Fig. 1. This figure also represents a section of a chuck and the nose of the spindle of a turret lathe.

The bonnet *B* is screwed into the chuck *C* until it shoulders. The plunger *D* is then forced against the housing of the screw in the bonnet by the lever and mechanism used for closing spring chucks in these machines. This movement locks the bonnet against the thrust of the tool and the reverse allows it to be readily unscrewed by hand after the cut is made.

The tool *A*, Figs. 1, 2 and 3, is made the shape desired, and is held in the shoe *E*, Fig. 1, by a hook bolt. The shoe *E* has




Top and Side Views of Forming Tool.

a clearance of 1-16 inch in a length of 6 inches. These tools when properly made give a fine finish to the work, do it fast, and will last a long time. The cutting angles of entrance and clearance are 8 degrees and 7 degrees respectively.

It is often necessary to make a second operation on screw machine work, which will require re-chucking. If the pieces

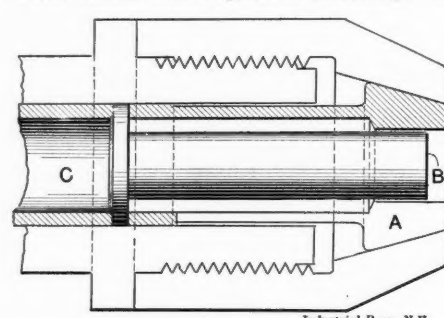
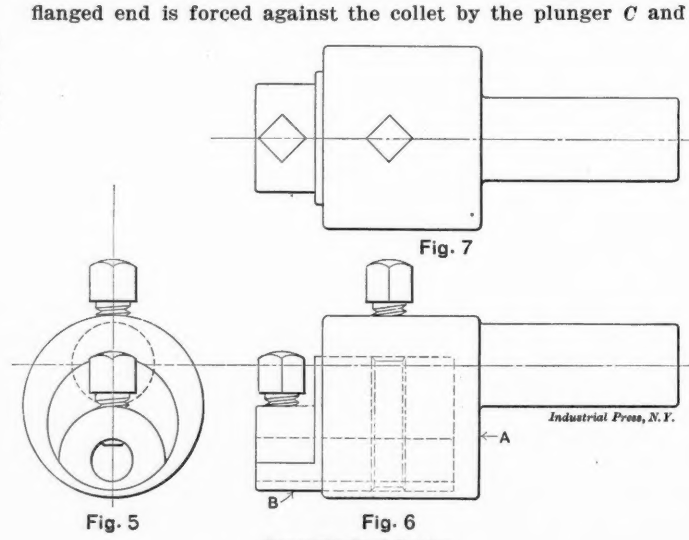



Fig. 4 Chuck for Re-chucking Work.

are short, Fig. 4 shows a good method of doing this. *A* is a cross section of a screw machine collet, and *B* is a stop piece. It is made to slip easily into the spindle of the machine and also to be a loose fit in the collet. Its length will, of course, be made to accommodate the work it is to support. The flanged end is forced against the collet by the plunger *C* and



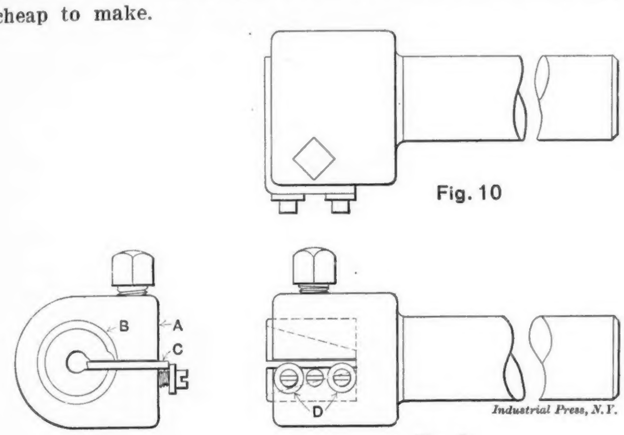

Eccentric Tool Holder.

the work locked in the chuck in the usual manner. It may in some cases be necessary to drill a hole through the center of *B* to accommodate some classes of work, but in any case the re-chucking can be accomplished in much better time and with equal accuracy to that of using a stop in the turret.

Figs. 5, 6 and 7 are the front, side and top views of an ec-

centric tool holder, that has some points of advantage for use in turret machines, particularly those that have cross feed to the turret carriage, as by its construction the tool may be so set as to obviate the necessity of a long cross movement on some kinds of work that are of large diameter. The shape of the tools may be made to suit the exigencies of the work, that is, they may be plain point tools or bent point tools with the bend in either direction.

As designed the tool consists of a holder *A* with a shank turned eccentric to the body of the holder and in the body a hole is bored eccentric to the body. Through the thickest part of the body a hole is drilled and tapped to receive a setscrew which locks the tool housing *B*, Fig. 6. The tool housing is made to turn freely in the body and has a recess turned in it to receive the impression of the setscrew. The cutting tool which is made of round steel should go easily into the hole, which it will be seen is placed eccentric to the body of the housing. Except for the difficulty of making fine adjustment with this tool, it is otherwise efficient and is quite cheap to make.



**Chamfer Tool.**

Fig. 8 is the front, Fig. 9 the side, and Fig. 10 the top view of a chamfer tool that is useful in truing up and chamfering the ends of castings that are to be turned in a turret lathe; particularly is this so when the turning is to be done by a box tool as the chamfer prepares the work, so that it may receive the steadyrests of the box tool.

The body *A* is bored to receive the hardened steel bushing *B*, and is slotted to take the cutting blade *C*. *C* is held in place by the setscrew and is adjusted to position by the collar screws *D D*, Fig. 9. The steel bushing *B*, Fig. 8, is bored with a taper hole to give the chamfer desired, and is slotted to receive the cutting blade *C*. Provision is made to receive the chips in the bushing by cutting away a portion of its wall.

J. R. Gordon.

Brooklyn, N. Y.

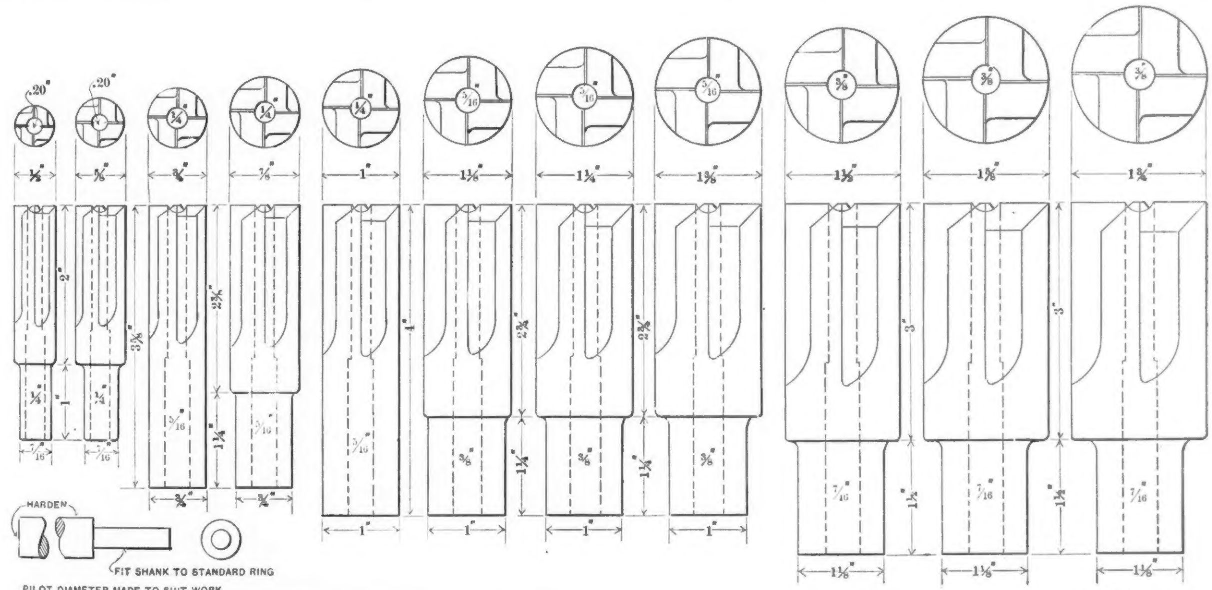
## SET OF COUNTERBORES.

*Editor* Machinery:

The accompanying cut shows a set of counterbores that I designed a number of years ago and which have proved very efficient. The holes for the pilot shanks are lapped to standard plugs so that the pilots will interchange. The pilots are made in all sizes as they are needed, the shanks being made to fit standard rings and the leading ends being hardened and ground.

The rule for cutting the grooves in the counterbores which leaves them fairly strong, is to cut them to a depth equal to one-half the distance from edge of pilot hole to outside of counterbore and to leave fillets of generous radius.

Lawrence, Mass. Fred J. Perry.



**Set of Counterbores, one-half inch to one and three-quarter inches inclusive.**

## COUNTERWEIGHTS FOR MACHINES.

*Editor* Machinery:


Frank B. Kleinhans.

The counterbalance is an essential part of a great many machines. In some cases the counterweight must be variable and in other cases it must be constant. Some counterweights are for stationary or standing balance only, while others move back and forth in a manner similar to the part which is to be counterbalanced. It is the latter case from which the greatest trouble arises. The counterweight which is used to balance the cutter of a slotting machine or the plunger of a pump are good examples of the case in question.

The counterweight of a punch plunger is subjected to severe treatment. This fact has made itself known in many hundreds of cases. The levers have been broken or bent, and the brackets which form the fulcrum have been knocked off or twisted out of line. A severe shock is evident in every part of the plunger and counterweight when punching large holes with a flat punch. The rupture of the metal occurs suddenly, and thus the resistance of the material disappears in an instant. When this occurs the energy stored up in the spring of the eccentric shaft, frame and various other parts of the machine is released and the plunger snaps down at a very high speed. As the mass of the counterweight is large it cannot accommodate itself quickly to the new speed, and thus we have a severe stress in the counterweight lever. All this is gradually augmented as the connections of the counterweight levers and links gradually wear loose, as there is thus a greater tendency to hammer. It is this hammering effect which more than anything else is responsible for the continual failure of counterweight levers.

The difficulty has been overcome by some builders by the use of springs in place of the usual links. This, of course, reduces the shock as the plunger snaps downward through the

work, and works very well, but the same thing can be accomplished by making the counterweight levers of steel and large enough so that they will withstand several times more weight than that which is used for the counterbalance.

Fig. 1 represents a counterbalance with an arm $A$ made of a steel casting, and large enough at the fulcrum $F$ so as to withstand the bending moment. The links $L$ are made of malleable iron and have ample bearing surface for the pins

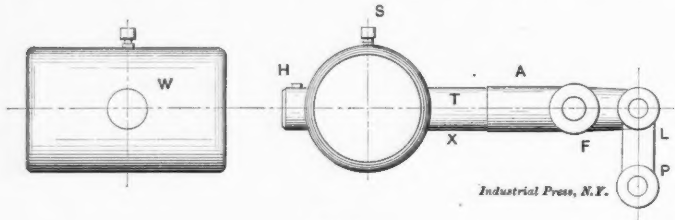



Fig. 1.

$P$. $W$ is the counterweight, and it is convenient in some machines to make this weight adjustable, as, for instance, where heavy special tools are interchangeable on the plunger with very light ones. The arm is then turned off at $T$ and the counterweight is bored out so as to form a neat fit. The weight can be clamped on the arm with a setscrew $S$.

There is another cause for the failure of a counterweight. This is owing to the fact that while we may have a perfect standing balance, yet when the machine is in motion the weight and the counterweight will be out of balance due to the difference in velocity at which the two are moving.

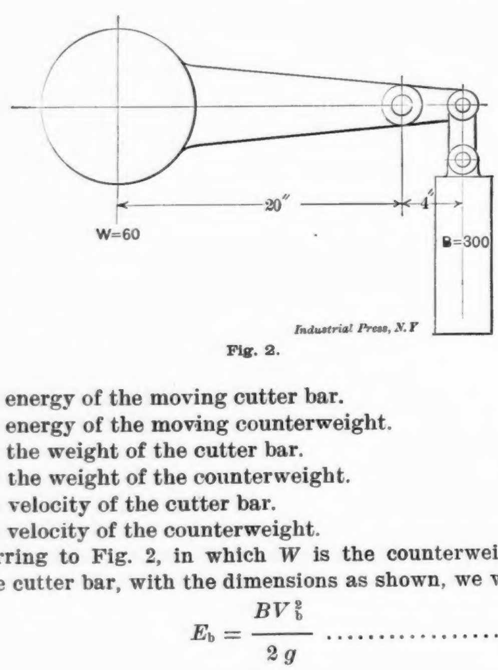



Fig. 2.

Let

$E_b$ = energy of the moving cutter bar.
$E_w$ = energy of the moving counterweight.
$B$ = the weight of the cutter bar.
$W$ = the weight of the counterweight.
$V_b$ = velocity of the cutter bar.
$V_w$ = velocity of the counterweight.

Referring to Fig. 2, in which $W$ is the counterweight and $B$ is the cutter bar, with the dimensions as shown, we will have

$$E_b = \frac{B V_b^2}{2g} \quad \text{.................(A)}$$

$$E_w = \frac{W V_w^2}{2g} \quad \text{.................(B)}$$

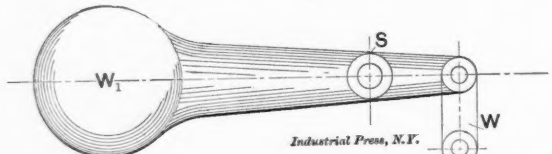



Fig. 3.

or since the velocity of the counterweight and cutter-bar are directly proportional to their arms, we have

$$V_w = 5\, V_b,$$

and substituting in (A) and (B) we obtain

$$E_b = \frac{B V_b^2}{2g} \quad \text{...................(C)}$$

$$E_w = \frac{W\, 25\, V_b^2}{2g} \quad \text{................(D)}$$

also for a standing balance we must have

$$B = 5\, W,$$

substituting in equations (C) and (D) we obtain

$$E_b = \frac{5\, W V_b^2}{2g} \quad \text{.................(E)}$$

$$E_w = \frac{W\, 25\, V_b^2}{2g} \quad \text{................(F)}$$

By comparing the equations (E) and (F) we see that the energy of the counterweight is five times as great as that of the cutter-bar. As these masses must be set in motion and again brought to a standstill, the system will be considerably out of balance. When the velocity of the counterweight is low the effect will hardly be noticeable, but when the velocity is great, as will be the case in speeding up a slotting machine, the effect is very marked—so much indeed that quite a number of counterweight levers have been broken.

The style of counterbalance and arm shown in Fig. 3 has been used for the counterbalance of slotting machines. Until very recently these arms have been made as shown in one solid casting and, as there was considerable metal in the weight $W$, the whole thing was made of cast iron. The result was that the arms would snap off at $S$. The way to overcome this difficulty is to make the arms of steel. This can be done by making a solid steel casting of the weight and arm, or by casting the iron weight on the arm or by slipping the weight over the arm through a cored or machined hole. It is better for a slotter counterweight to have the weight fastened securely to the arm so that there is no possible chance for the weight to be thrown off or for the weight to get loose and hammer on the arm. This hammering effect is hard on all of the reciprocating parts of the machine. The links $W$ should never be made of cast iron as this material is too uncertain in tension.

When the counterweight is adjustable, as shown in Fig. 1, we can readily shift the weight so as to give a reasonably good balance when the machine is running at a high velocity. It is always best to have the hole in the weight machined, so as to form a snug fit in the arm. In Fig. 1 this is easily done, as both the hole and arm are round. A headless setscrew $H$ will prevent the weight being thrown off in case the screws become loose. FRANK B. KLEINHANS.

## TWO SMALL MILLING JOBS.

*Editor* MACHINERY:

I submit herewith description of a couple of milling operations which I think may prove interesting to some of your readers. In both cases a doubt was expressed as to the possibility of doing the work at a reasonable cost, but when the proper facilities were provided the labor cost in both instances was very small indeed.

In the first instance it was required to mill in opposite sides of a small cast-iron cylinder head two angular slots 3-16 inch wide and about 3-32 inch deep. Two pins in the inside of the cylinder engaged in these slots, thus forming a double bayonet lock which drew the head invariably until the flange came to a bearing against the end of the cylinder. Inside the cylinder was a shaft, one bearing of which was the hole through the center of the head and as this shaft always revolved in the same direction its friction tended to keep the two parts tightly drawn together. At the same time they were easily separated by turning in the reverse direction.

Fig. 1 shows the cylinder head, and Fig. 2 the fixture, or more properly, machine, by which the work was done. Referring to Fig. 2, $A$ is the main frame, $B$ $B$ the spindles for holding the small end mills and $C$ the shaft that carried the piece in which the slots were to be milled. Upon this shaft was secured the cam $D$, in the slot of which the roller $E$ traveled.

The cam was made the same diameter as that part of the piece $F$ in which the slots were to be made, so the cam slot angles and rises were identical with those to be cut in the work. The wide slot across the end of the piece to be operated on was utilized to hold the work securely in position during the milling operation and at the same time served to locate

the slots always in their proper position, which was necessary.

As this work was expected to run into thousands, the machine was made with hardened tool steel spindles running in bronze bushings, the bearings being taper and adjustable for

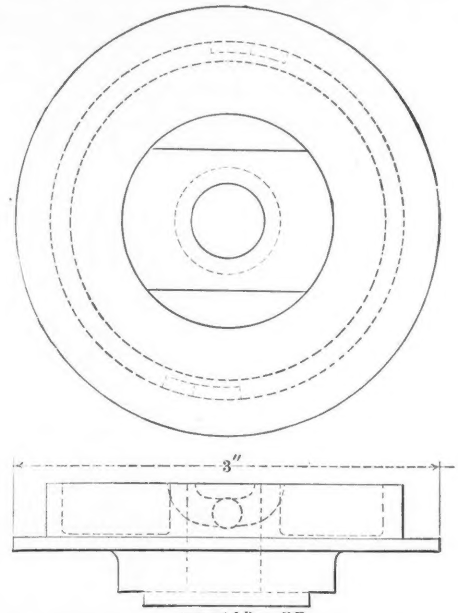



Fig. 1. Small Head in which Slots were Milled.

wear. The spindles were hollow and fitted with draw-in collets for holding the end mills which were made from Stubbs steel. There was also a special countershaft which is not shown in the drawing.

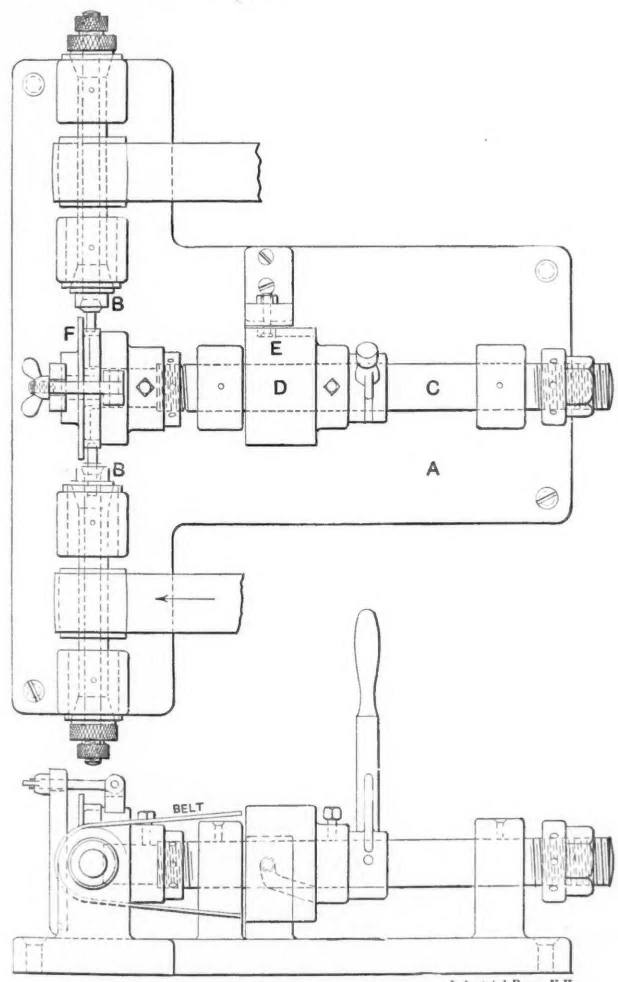



Fig. 2. The Rig for Milling two Slots at once.

When the operator had secured the work in position, he grasped the handle, first pushing it toward the rear of the machine and then toward the left until the cam stopped against the bracket when the slots were finished. The reverse movement brought the work back to its original position, when it could be removed. The average time required to secure the work in the machine and mill the slots was one-half minute. No trouble whatever was experienced with the end mills. They stood up to the work until worn out.

In the second example the work presents more difficulty, for the mills are smaller and more delicate and the form of tooth is such that the strain in cutting is greater. Added to this the material to be operated on is tool steel instead of cast iron.

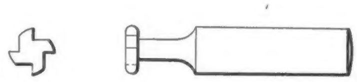


Fig. 3.

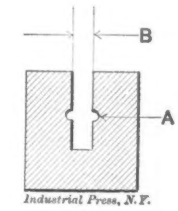



Fig. 4.

Fig. 3 shows one of the mills used for the work, and Fig. 4 a section across one of the pieces to be operated on. There were three sizes of these, the radii of the semicircles at *A* being .025 inch, .0185 inch and .015 inch. Dimension *B*, which determined the size of the shank of the mill, and the "weakest spot," was .075 inch, .051 inch and .046 inch. The length of cut was about 2½ inches.

The work was done on a No. 1 plain milling machine, but not until all the bearings had been cleaned, scraped and tightened until there seemed to be absolutely no shake in the machine. The cone pulley was removed and the driving belt run directly on the spindle and a much larger pulley than usual was used on the line shaft, so that a very high rate of speed was obtained. Occasionally one of the mills would break, but the writer is inclined to attribute this to the fact that the milling machine was so placed that it was subjected to sudden jar transmitted through a springy floor from heavy machinery near by.

The success met with in the above described operations leads him to think that with proper facilities, viz., machinery with practically no lost motion and a sufficiently high speed, these delicate milling operations are no more difficult than those on a larger scale. WAITE J. BEVERTS.

## TO ANNEAL SPOTS IN HARDENED STEEL.

*Editor* MACHINERY:

Having noticed an article by F. J. K. in the March issue of MACHINERY, it struck me as a rather queer method to anneal spots on ⅛ inch by 15 inch circular saws (for the purpose of drilling holes) by glazing an emery wheel and creating friction enough to get the desired temperature. While I do not question the fact that the desired result can be obtained in this manner, I think it is not the best way to do it.

Assuming that F. J. K. had ready access to a forge (and what machine shop nowadays has not a forge of some description?), it would have been "dead easy" to take two pieces of, say, 1-inch rod machine steel about 2 feet long and bring the ends thereof up to a white heat. Then, having previously laid the saws on a flat surface of some sort and marked the spots to be annealed with a bit of red lead, hold the heated end onto the spot—a fraction of a minute would do the trick, I assure you. While one rod is being used the other is being heated. The entire dozen saws could in this manner be effectively annealed in a short time. HARRY ASH.

Chicago, Ill.

* * *

In the modern industrial railway equipment where turntables are used for out-door work there is a temptation to set the turntables upon too shallow a foundation, the result being that they are thrown out of line by the influence of the frost. In our recent description of the B. F. Sturtevant Foundry there was an illustration of the turntables used, and we are informed that they have withstood the action of frost in a very satisfactory manner. Each turntable rests at the top of a brick circular well with 8-inch walls extending to a depth of 4 feet, or below the frost line. These walls are set upon hard-pan and the center filled with loose stones, providing perfect drainage.

## HOW AND WHY.

**A DEPARTMENT INTENDED TO CONTAIN CORRECT ANSWERS TO PRACTICAL QUESTIONS OF GENERAL INTEREST.**

**Give all details and name and address. The latter are for our own convenience and will not be published.**

33. C. W. B.—Could you advise the writer if there is a solution or solder for soldering brass and steel together without rusting?

A.—We submit this question to our readers.

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34. R. E.—What is the principle of the "pyrometer" used for measuring high temperatures?

A.—An explanation of the principles that have been employed in the construction of pyrometers would be too lengthy for this department. You are referred to the review of the subject that appeared in the February, 1904, issue, Engineering Edition.

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35. G. W. S.—I would like to know how to make the soft solder or composition such as is used in automatic fire sprinklers, which will melt at a low temperature. Can you give me directions for making the same, or is it a secret known only to the makers?

A.—We referred this inquiry to Mr. Everett W. Crosby, General Agent of the North British & Mercantile Insurance Co., New York, who states: "Sprinkler solder is ordinary soft solder—commonly called low test solder—used on these heads, and is composed of the following materials and in approximately the proportions named: Bismuth, 5 parts; cadmium, 1 part; tin, 2 parts; lead, 3 parts.

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36. A. F. B.—Are not "pitch" and "lead" the same when applied to screws? For instance, is not an 8-pitch screw the same as one of ⅛-inch lead?

A.—Pitch and lead are in effect the same when applied to single-thread screws only. A single-thread screw of 8 pitch has a lead of ⅛ inch per turn, but a double-thread screw of 8 pitch has a lead of ¼ inch per turn, and a quadruple-thread screw of 4 pitch has a lead of 1 inch. Pitch means the distance, center to center, between adjacent thread sections; lead means the distance between successive turns of the same thread element. That is, in a quadruple thread of say 4 pitch, the distance a nut will travel lengthways of the screw in one turn, is the lead, and in this case, is 1 inch, and it would be the same if it were a sextuple thread. This is shown by the fact that an engine lathe is geared the same for cutting a multiple thread as for a single thread *of the same lead.* The distance between two successive threads is divided into, say, three parts for a triple thread, and this is done by adjusting the tool, or "jumping" the split nut on the leadscrew if it chances to be one-third, one-sixth, etc., the lead of the screw being cut; and not by changing the gearing.

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37. R. M. F.—Can you give a good method of tempering small springs, such as gun springs and small flat springs?

**Answered by E. R. Markham.**

A.—The method pursued when hardening small springs must depend on the equipment of the shop where the work is done. If the equipment includes a hardening furnace, provided with a means of feeding the springs through the fire and dumping them automatically in the oil, well and good. If not, they may be placed in a tube or on a piece of sheet iron bent in the shape of a shovel. These are then heated red hot and dumped in a bath of oil, or tallow. Care must be taken, however, that they do not go in a mass or some of them will harden unevenly or not at all. They must be "sifted" or scattered. Sperm oil, or lard oil, makes a good bath. Tallow will harden, harder than either. A mixture of sperm oil and tallow (equal parts) to which is added a little beeswax, will produce good results when any of the others fail. Resin added to the oil also makes a good hardener; however, sperm oil generally proves all right. When drawing temper, best results follow the use of hot oil, and of a thermometer for gaging the amount of heat, which varies with the steel used and the use to which the springs are to be put, and can be determined only by experiment.

"Flashing" is often used when tempering, and works nicely when practiced by one expert in such practice. The best method for ordinary purposes consists in placing the springs in an iron pan having a long handle and shaking the springs over a fire until heated to the proper temperature. This can be determined by placing a small piece of tallow, or a little lard, or sperm oil, in the pan—just enough to smear the springs. When this catches fire and burns from the internal heat in the springs, dump into a dry box where no current of air can strike them. For some steels this method cannot be used, as the springs would be drawn too low.

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38. W. J. H.—Kindly inform me what is the pressure at the point of a turning tool when cutting cast iron. That is to say, suppose we are turning the outside of a 20-inch faceplate, removing ⅛ inch on a side at 1-16 inch feed per revolution, what is the pressure on the point of the tool.

A.—The most complete information on this subject is contained in Flather's "Dynamometers and the Transmission of Power," in which are collected data from many tests upon various kinds of machine tools. Since the introduction of high-speed steel, however, conditions have changed so much that the deductions from the tables mentioned would be to a certain extent incorrect. Probably the most satisfactory way to determine the pressure on a tool is to obtain this from the power required to drive the machine when cutting. Knowing the horse power, if we multiply this by 33,000 we have the foot pounds per minute; dividing this by the cutting speed in feet per minute will give the pressure on the tool, neglecting the power lost in overcoming the frictional or other resistances in the machine itself. In tests upon high-speed cutting steels at the Manchester Municipal School of Technology, to which we shall presently refer, it was found that the power absorbed by the machine varied greatly with the temperature of the bearings and also with the speed. After the bearings become warm, the oil is more viscous, which makes an appreciable difference; and tests also show that it sometimes requires more power to run a lathe at high speed—as would be the case when filing a piece of work—than when taking a heavy cut at a slow speed. These facts indicate the degree of care necessary in arriving at reliable information upon the subject of your inquiry.

Referring to the tests in Flather's text book, we find the following formulas deduced from average results, which give the horse power required to remove a given weight of cast iron, wrought iron or steel:

For cast iron, horse power equals...... $.026 \times W$.
For wrought iron, horse power equals.. $.03 \times W$.
For steel, horse power equals ......... $.044 \times W$.

In each of these $W$ is the weight in pounds of the metal removed per hour.

The most complete information upon power required with high-speed steels is that obtained by the English tests at the Manchester Municipal School of Technology. These are very elaborate and cannot easily be summarized, but the following statement of results will answer our purpose and throw some light on the subject:

CUTTING SOFT STEEL.

| | Weight per Hour. | Horse Power. |
|---|---|---|
| Light cut | 105 | 3 |
| Heavy cut | 445 | 15 |

CUTTING CAST IRON.

| | Weight per Hour. | Horse Power. |
|---|---|---|
| Light cut | 42 | 1.7 |
| Heavy cut | 198 | 5.5 |

Applying Flather's formulas to these results we find that for steel the horse power required would be 4.6, instead of 3, for light cutting; and 19.6, instead of 15, for heavy cutting. In the case of cast iron we find the horse power would be 1.1, instead of 1.7, for light cutting; and 5.15, in place of 5.5, for heavy cutting. This would indicate that Flather's formula for steel allows more power for soft steel than was shown to be actually required by the English tests, and will probably give ample power for a considerably harder grade of steel. In the case of cast iron his formula appears to apply very closely, but giving results slightly too small.

From these comparisons it would seem that the rule to

multiply the weight of metal removed per hour by .04 would give a safe value for, the horse power for both steel and iron.

Further examination of the results of the English tests shows that with the steel more metal was removed per horse power when taking a heavy cut than when running at high speed and taking a light cut; while when cutting cast iron this condition was reversed.

It was found that the cutting force did not vary much with the speed because at high speed the cuts were light while at low speed the cuts were deeper and taken with a heavier feed. The pressure on the tool increased very rapidly as the tool became dull; but when the tool was in good cutting condition the following pressures were recorded:

| | Tons. |
|---|---|
| For soft fluid compressed steel | 115 |
| For medium fluid compressed steel | 108 |
| For hard fluid compressed steel | 150 |

| | Tons. |
|---|---|
| For soft cast iron | 51 |
| For medium cast iron | 84 |
| For hard cast iron | 82 |

It will be noted in reiewing these pressures that those for steel appear to be a little irregular, but they are as recorded in the results of the experiments cited.

39. E. F. R.—In an article on lining up shafts which I recently saw in an engineers' journal it was stated that a No. 24 standard steel wire was stretched by tension nearly equal to its breaking strength over a trough of water 100 feet long to find the amount of vertical deflection. The sag in the middle was found to be 11-32 inch. It further says that this amount would be doubled in a wire 200 feet long, and halved in one 50 feet long, with the same tension and size of wire. Is it possible to stretch a steel wire so as to have so little deflection in 100 feet, and does the sag vary directly as the length of span?

A.—The sag in a steel wire 100 feet long stretched to nearly its breaking point will depend upon the strength of the steel used in making the wire, and that varies widely. Ordinary crucible steel is rated at 100,000 to 120,000 pounds per square inch of section; plough steel wire, 200,000 to 250,000 pounds; and piano wire, 300,000 to 340,000 pounds. Taking the first value (100,000 pounds) a wire No. 24 (Washburn & Moen) gage should have an ultimate breaking strength of 41.5 pounds. Say that the allowable tension is 40 pounds (which is high), then from the formula:

$$d = \frac{l^2\,w}{8t} \text{ in which}$$

$d$ = dip or sag at middle of span
$l$ = length of span
$w$ = weight of wire per foot of length
$t$ = tension in pounds

we get the equation:

$$d = \frac{10{,}000 \times 1}{8 \times 40 \times 725} = \frac{1}{23} \text{ foot} = .52 \text{ inch dip or sag.}$$

Allowing the ultimate tensile strength of the wire to be 200,000 pounds per square inch of section, the sag of the wire could theoretically be reduced one-half or to .26 inch and so on. But, with the same tension, the dip varies as the square of the length of span. Hence in a span 200 feet long the dip would be four times the above amounts supposing the wire was stretched to the same tension; and or a span of, say, 50 feet, it would be only one-fourth as much.

* * *

## MECHANICAL TERMS: A CRITICISM.

Our contributor, Mr. Ridderhof, takes exception to the use of the term "back rest" for "center rest," as applied by Mr. Markham in his article on tool making in the March number. This introduces the interesting question of what determines right and wrong usage in machine shop parlance. The editors think that "center rest" more nearly expresses the object of a support for the outer end of a piece of work held in the chuck of a lathe, when the end is to be bored, reamed or threaded; but at the same time a "back rest" might be said to be a rest for the back or tailstock end as opposed to the headstock end of a lathe, which would be perfectly correct. It is common for a machinist to speak of "back resting" a piece of work, and there must have been good reason for originating this term, so frequently used.

We have examined the works of several writers, and find, for example, that Prof. Van Dervoort, in his book on shop practice, uses center rest and steady rest as synonymous, and follow rest to indicate the support attached to the back of the lathe carriage, but does not employ the term back rest. On the other hand, Pratt & Whitney, in their catalogue, use the term back rest to the exclusion of center rest. In the Brown & Sharpe treatise on grinding, center rest and follow rest are applied as usual and back rest is employed for a support placed back of the work opposite to the wheel, but which remains stationary and does not travel with the table. Mr. Ridderhof, in his letter, also makes the following remarks:

"I have little inclination to criticise Mr. Markham's work, as I have in the past read much of it with pleasure and profit, but I would like to call attention to a few statements by which I believe the young fellows, for whom the article in question was evidently written, are almost bound to be misled.

"Mr. Markham, antagonistic to our endeavors to make the boys leave the file alone, advises filing the pilot and shank of a counterbore to size. This is a little too much; and why, in milling the flats on the body of this tool with a "shank" (end) mill it should be necessary to notice the reading of the graduated dial I do not understand. The work is fed vertically past the mill and clearly no vertical setting is required.

"But of more importance than this is the lapping of the body of a counterbore and taking care to measure this only at a temperature of about 70 degrees. Where, oh where, is a counterbore used that needs to be so accurate? I've never worked at anything finer than watches, nor much rougher than windmills, but within that range no problem of lapping a counterbore and the consideration of its expansion and contraction at different temperatures has ever presented itself. If a difference of a few degrees would introduce inadmissible inaccuracies, what are we going to do when our counterbore heats up to 180 degrees in ordinary use? Are we to experiment with it and find at what rate of speed and feed it will attain a certain temperature and then lap it at that temperature so as not to spoil our work? I would much appreciate it and I'm sure my fellow readers would also like to have Mr. Markham explain how he overcomes or compensates for this rise in temperature and consequent expansion which is bound to accompany their actual use. Perhaps they are made for show case use.

"I hope Mr. Markham will accept the above blunt criticism as written by one who has learned much from him on the subject of hardening and tempering, one who writes with reluctance but cannot permit what he believes to be important errors to pass uncriticised in a journal devoted to, and exceedingly successful in helping mechanics of all grades to a better understanding of their trade."

This letter was submitted to Mr. Markham, who writes:

As to the term "back rest" I will explain that as a boy and apprentice I was taught to use the term "center rest," but as I was brought in contact with skilled mechanics I found the majority used "back rest," as Joshua Rose's "Machine Shop Practice." Dictionary of Machine Shop Terms, under "steady rest" or "back rest," defines it as a device for steadying work in the lathe. It is often so used by writers on machine shop subjects and in fact I have seen it oftener than either steady or center rest. I feel that the young man should become familiar with all the different terms as applied to parts of machines.

As to the use of the file, and the advisability of discarding it, I find a tendency in most shops to do away with its use where practical, but to want the operator more skillful in its use than ever before when necessary. If Mr. Ridderhof is not teaching his apprentices to be skillful filers I am sorry for them. The book on tool making, published by the International Correspondence Schools, which I consider the best thing on the market, describes the use of a file on counterbores and also uses "steady rest" and "back rest" to designate the same thing.

In the matter of using water of about a certain temperature when cooling pieces being lapped, our friend must know the danger of gaging work when hot which when cool would be smaller; and as to the necessity of keeping the water at exactly 70 degrees, such expressions are not meant to be taken altogether literally. A certain temperature must be given, and as gage lapping requires approximately a certain temperature for measurements to insure passable results, it is always considered safer to err on the safe side. I would say just a word; I don't think Mr. Ridderhof would use a lapped counterbore—which is an unusual thing—on a job when it was to be heated to 180 degrees. The statement in the article would free one's mind of the thought that it was often necessary to lap a tool of this kind, but when it is necessary the young man should know how to do it.

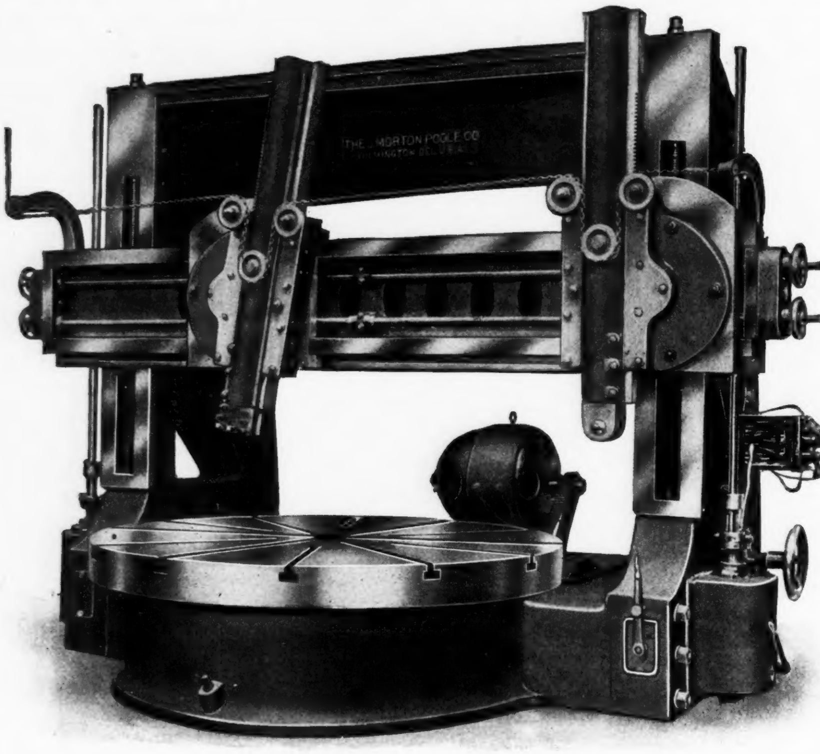
E. R. MARKHAM.

# NEW TOOLS OF THE MONTH.

## A RECORD OF NEW TOOLS AND APPLIANCES FOR MACHINE SHOP USE.

### POOLE MOTOR-DRIVEN BORING MILL.

In our October, 1903, number we illustrated a new boring mill that had been brought out by the J. Morton Poole Co., Wilmington, Del. This mill had several features of distinction, the most prominent of which was a worm-driven table in place of the usual spur driven table. The illustration herewith shows their late type of this mill, equipped with electric motor, which provides for a speed reduction of 50 per cent.




Poole Motor-driven Boring Mill.

which, in connection with the back-gear ratios of 12, 36, 95 and 285 provided in the mill, enables the operator to obtain any desired table speed between ½ and 24 revolutions without stopping the mill. Any make of motor, or system of speed control, can be used with equal advantage.

The rapid traversing shaft for crossheads and tool bars is driven from the back gear shaft in the bed by means of a silent chain. The usual handwheels on the crossheads are omitted, as the tool bars are raised and lowered by power. For close adjustment of tools the operator places the crank handle on the upper rod; the absence of these hand wheels and all overhead cross-rail elevating mechanism, the inclosing of all gears to protect them from dirt and accident, the location of the cone pulley or motor on the bed between the uprights, and the small number and convenient location of operating levers and hand wheels, as well as the great driving power and rigidity possessed by the mill, make it a tool which is fully up to modern machine shop practice in every particular.

### IMPROVED POST DRILL PRESS.

An improved post or wall drill press recently brought out by Boynton & Plummer, Worcester, Mass,, is shown herewith. The drill is designed to be fastened to the wall or post by brackets, which are cast on the upright column for this purpose, thereby taking up much less room than the ordinary floor drill, yet containing all of the features of the floor drill. It has a swing of 24 inches and the spindle, which is counterbalanced by weight in the upright column, has a vertical traverse of 11½ inches and is bored with a No. 3 Morse taper socket. The table can be swung around the upright column at any angle and has a vertical traverse of 18 inches operated by rack and pinion. The greatest distance between spindle and table is 24 inches, which allows work of large dimension to be handled.

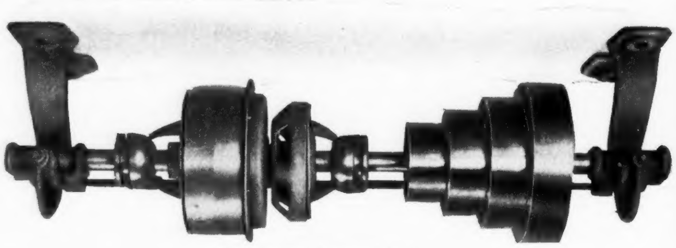
The machine is equipped with both lever and screw feed, which can be changed instantly from one to the other by a small lever that throws the feed worm in or out of mesh with the worm gear. The lever is arranged with a notched ratchet by which the entire traverse of spindle can be operated with the lever always at a convenient point or angle. This drill

Post or Wall Drill Press.

has a 4-step cone pulley of the following dimensions: 11 inches, 8¾ inches, 6¼ inches, and 4 inches for 2¾ inch belt and is furnished with countershaft to match. Driving pulleys on countershaft are 10 inches for a 3-inch belt and should be run at 230 revolutions per minute. The entire length of drill is 72 inches; weight, 610 pounds.

### SMITH ONE-BELT REVERSING COUNTERSHAFT.

A one-belt reversing countershaft is illustrated herewith, as manufactured by the Smith Countershaft Co., Melrose, Mass. In the detail engraving pulley *G* is the driving pulley on which the single belt runs and this pulley is made to operate the countershaft either in a backward or forward direction by means of two friction clutches and a train of gearing. The pulley is loose on the shaft but can be rigidly connected with the shaft by means of the friction clutch *K*, shown at the right, which causes the shaft to revolve in the same direction as the pulley. This clutch is of the conical-shaped type, and is thrown in or out by means of the spool which forces apart the fingers and draws the two clutch surfaces together. The conical part of this clutch is keyed to the shaft. For obtaining the reverse motion there are three rawhide pinions



Reversing Countershaft.

—of which one is shown at *M*—which mesh with internal teeth cut on the inner surface of pulley *G*, and also with external teeth on the outer surface of the gear *F*, which latter is keyed to the shaft. The three rawhide pinions are supported by a three-armed spider, *D*, which has a long hub to which is threaded the friction clutch *A* at the extreme left end. When the pulley and shaft are turning together gear *F*, of course, turns with them, and the rawhide pinions, as well

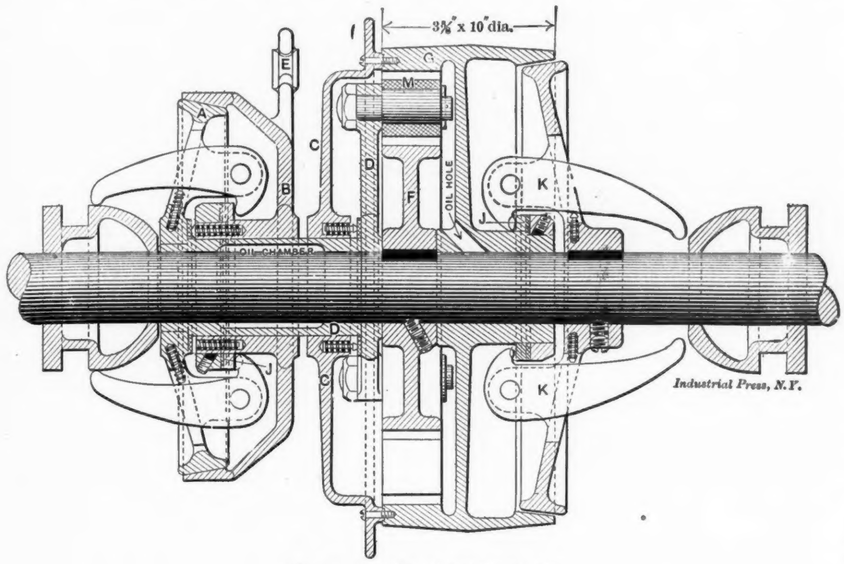



Fig. 2. Details of Countershaft.

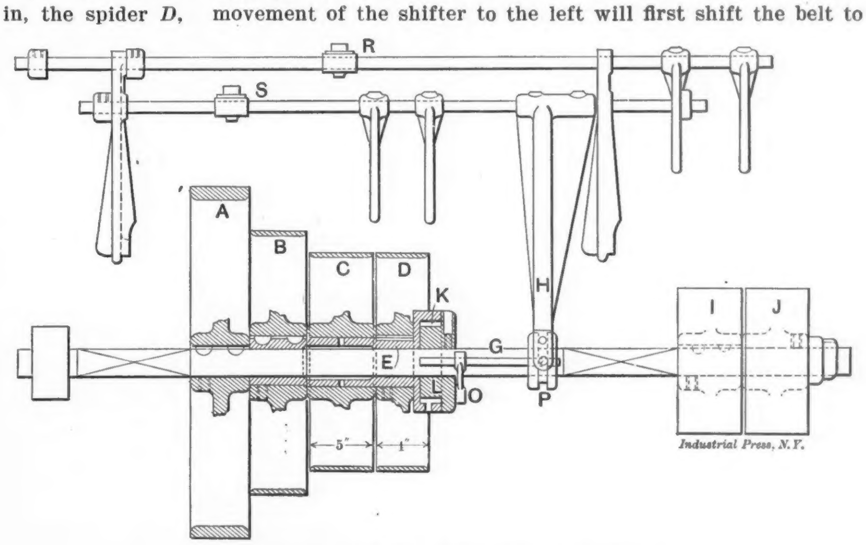
as the spider *D*, also revolve, these several parts rotating as one body. If, however, the clutch *K* which locks the pulley with the shaft were disconnected, and the spider *D* which carries the rawhide pinions were compelled to remain stationary, it is evident that the pinions would then act as intermediate pinions, causing a reversal of the motion between pulley *G* and gear *F*, thus making the shaft rotate in a direction opposite to that in which the pulley is turning. This is accomplished by means of the clutch shown at the left, which locks cone *A* with the conical-shaped casting *B*. Casting *B* is prevented from turning at all times by means of a projecting arm, *E*, and hence when clutch is thrown in, the spider *D*, which carries the rawhide pinions is held rigidly in one position. The two spools for working these two clutches are under the control of a single shifting lever, and when the lever is moved in one direction it disconnects one clutch and throws in the other one, while if moved in the opposite direction it disconnects the latter clutch and throws in the former, thus reversing the motion of the countershaft. If the shifter is left in the middle position both clutches will be disconnected and the pulley will be rotated loosely on its shaft while the shaft itself remains stationary. Several details of construction of this countershaft have been ingeniously worked out, such as the means for oiling the spring pins for forcing apart the clutches, so as to avoid sticking of the surfaces and the flange *C* which forms the outer bearing, as it were, for the pulley, to compensate for the part of the pulley hub that is cut away where the gear *F* comes. The advantage claimed for a countershaft of this description is that the belt pull is always in one direction, so that with a reversal of load there will be no flapping of the belt. The countershaft has been thoroughly tested and is said to show no appreciable wear, while the rawhide pinions produce quiet running.

## TWO-SPEED COUNTERSHAFT.

A new two-speed countershaft has been brought out and patented by the Cincinnati Planer Co., Cincinnati, O., which is now supplied with their planers at a slight additional cost. On the countershaft there are two pulleys for the planer belts, one of small diameter for the cutting stroke and one of large diameter for the return. There are also two pairs of tight and loose pulleys, by means of which the countershaft is driven at different speeds through a belted connection. In the illustration, *A* is the large pulley for driving the planer during the return of the platen. This pulley is connected to the shaft and is always driven by the tight pulley *I*. Pulley *B*, however, which drives the planer during the cutting stroke is not keyed to the shaft, but instead is attached to a long sleeve which can turn freely upon the shaft. Upon this sleeve are also the tight and loose pulleys, *C* and *D*, and the speed at which *B* rotates, and consequently drives the planer, depends upon whether sleeve *E* is driven by pulley *I* or by pulley *D*. If it is to be driven by *I* the sleeve must be connected with the shaft, which is accomplished by means of a friction clutch; if it is to be driven by *D* the friction clutch must be thrown out so that the sleeve will be free to turn upon the shaft.

There are two shifter rods, *R* and *S*, shown in the upper part of the engraving, for manipulating the countershaft. The upper one carries a fork for shifting the belt upon pulleys *I* and *J*. The other one shifts the belt upon pulleys *C* and *D*, and also operates the friction clutch by means of the lever *H*. The clutch is located within a recess at the end of the bushing *E*. It consists of a hub *L*, keyed to the shaft, between which and the inner surface of the recess is a split ring *K*. The ends of this ring are forced out by an eccentric pin which can be rotated slowly by means of the lever *O*. This lever in turn receives its motion from a sliding feather attached to the spool *P*.

It will be seen that the shifter rod *R* need be used only for starting up the high-speed return pulley *A*, and that the two cutting speeds are obtained entirely by means of the single shifting rod *S*. Supposing the belt to be running on the loose pulley *C* the movement of the shifter toward the right will first disconnect the clutch and then shift the belt on to the tight pulley *D*, whence *B* and *D* will turn together. Then a movement of the shifter to the left will first shift the belt to



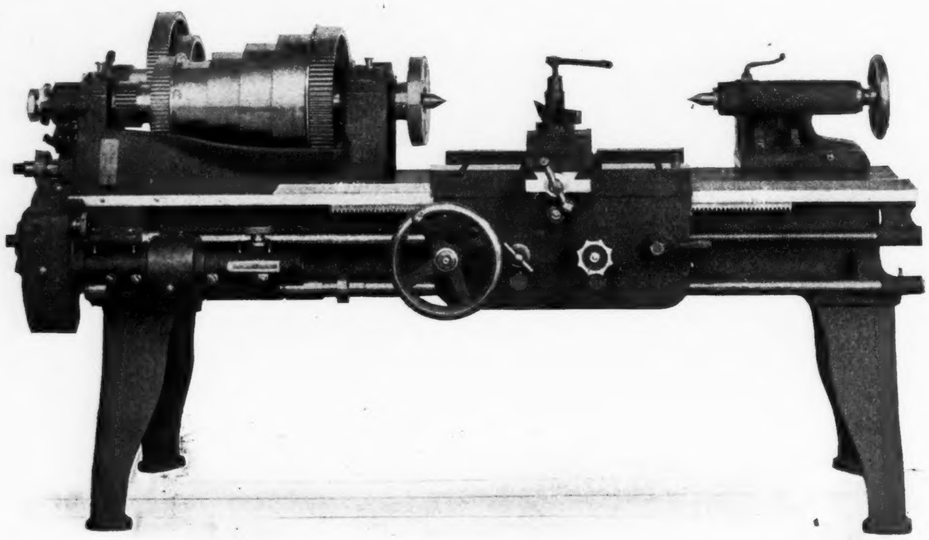

New Countershaft of the Cincinnati Planer Company.

the loose pulley, stopping the motion of pulley *B*, and then throw in the clutch, causing *B* to start again under the influence of pulley *I*, which will drive it at a slower speed.

## LATHE FOR HIGH-SPEED STEELS.

The cut on next page shows an 18-inch engine lathe designed for use with high-speed cutting steels, that has recently been placed on the market by the F. E. Reed Co., Worcester, Mass. This lathe is a pioneer in its line, from the fact that it is designed with ample power for turning work up to the full swing of the lathe with the best high-speed steels. Heretofore, so far as we know, the high-speed lathes have been designed for turning smaller diameters only. The builders write us

that this lathe has more power in the head and more strength in the feed works than any of the high-speed cutting steels will stand when cutting to the limit of their endurance. In other words, the lathe is ahead of the steels, and is capable of doing a larger range of work, and more of it, in a given time, than the tool will stand.



Reed Lathe for Turning up to 18 inches Diameter with High-speed Steels.

This lathe swings 18 inches over the bed and with 8-foot bed takes 3 feet 6 inches between centers. It weighs 3,470 pounds. The head spindle has a front bearing 3⅝ inches diameter by 7½ inches long. The cut shows the lathe with a four-section cone pulley, the largest section being 15 inches diameter for 3½-inch belt, with a small ratio and a large ratio of back gears. With open belt and small ratio of gears, iron or steel may be turned, up to 5 inches diameter, cutting as many feet per minute as the best high-speed steels will stand. The lathe also has power enough to take any depth of cut, and any feed desired from 40 cuts to 8 cuts per inch. With the large ratio of back gears any work can be done in the lathe from 5 inches diameter up to the full swing of the lathe, in either cast iron or steel. The diameter of the cone pulley and the ratio of gearing are so made that the lathe has a regular gradation of spindle revolutions per minute, from 400 to 10. This is ample range for turning any diameter up to the full swing of the lathe, at any cutting speed desired.

The rest is extra heavy and has a bearing on the bed its entire length, or 36¾ inches, and is stiff enough to stand any strain required of it. The feed works are amply strong in proportion to the rest of the lathe. The vees on which the rest slides have more than twice the wearing surface of the ordinary lathe of this swing. Cutting tools may be used as large as ¾ inch x 1¼ inches.

This lathe may be furnished with pan, pump and piping, if desired, for flooding the cutting tools with water or other lubricant.

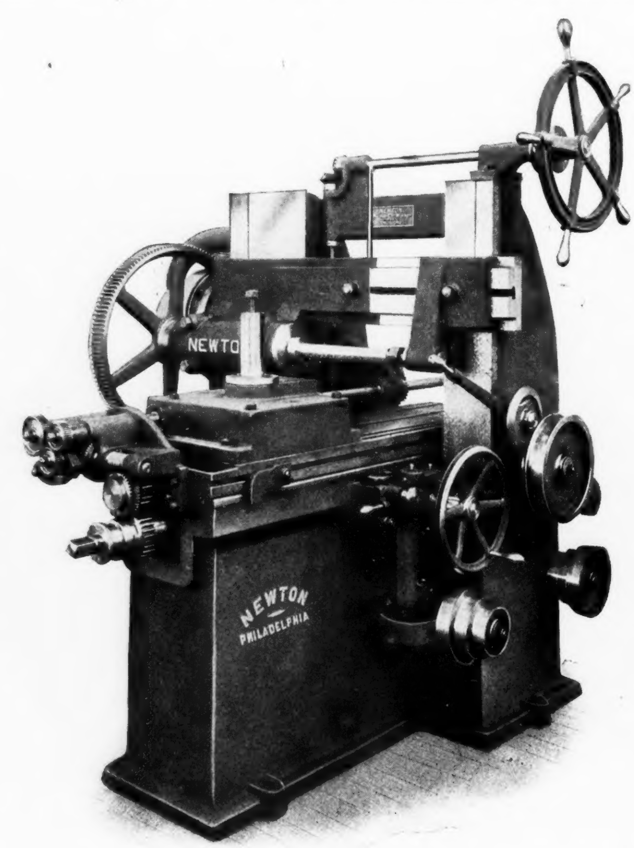
## NEWTON WORMWHEEL CUTTER.

The cut herewith illustrates a new plain milling machine manufactured by the Newton Machine Tool Works, Philadelphia, Pa., arranged as an automatic wormwheel cutting machine. The table is 6 feet 6 inches long, giving the machine a capacity for wormwheels up to 48 inches in diameter, and the machine will swing a cutter up to 7 inches in diameter. The spindle which drives the worm wheel is 2 11-16 inches in diameter and is revolved by an accurately cut wormwheel and worm of steep lead through change gearing which mesh directly into the driving gear. The feed motion to the table, when the machine is being used for cutting wormwheels, is obtained from the dividing shaft by gearing, and acts directly on the feed screw through a clutch which is clearly shown on the end of the machine.

The machine is also well adapted for cutting the Hindley type of worms and wormwheels. The worm to be cut is placed on the cutter arbor, and the cutter on the vertical spindle of the dividing box.

When it is desired to use the machine for milling it is only necessary to remove the dividing box and shaft which are shown clamped to table.

For milling, the machine has six changes of automatic feed and power quick return, as shown in the half-tone, and will mill work up to 6 feet in length. The table of the machine is



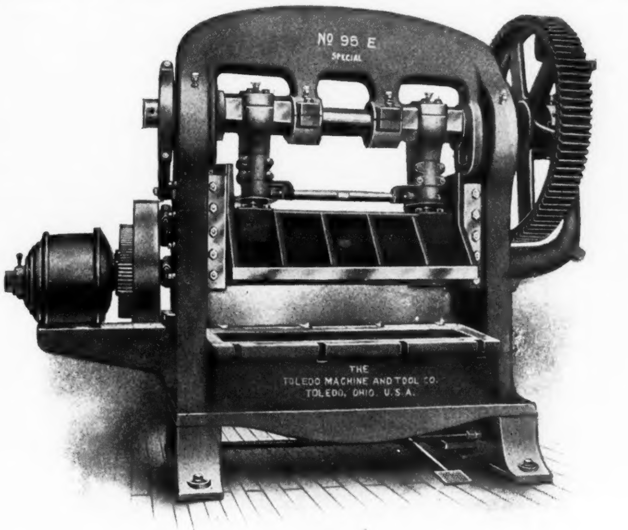

Newton Wormwheel Cutter.

16 inches wide and 6 feet 6 inches long, and the uprights will admit work 20 inches wide.

## TOLEDO POWER PRESS.

One of the new types of motor-driven crank power presses is shown in the accompanying cut. This machine weighs about 40,000 pounds and will exert a pressure of 500 tons, yet motor connection is such that less than 4 horse power is required to operate the press. The slide bearings are of special design, and the slide adjustment is unusually long and pro-

vided with a new clamping device on the pitman screws. The clamp is provided with a cap and four studs which lock the adjustment. Bevel gear connection between the two pitman screws is used for adjusting the slide to various heights. The manufacturers attribute the small amount of power required for operating this press to the style of clutch used, which is of a

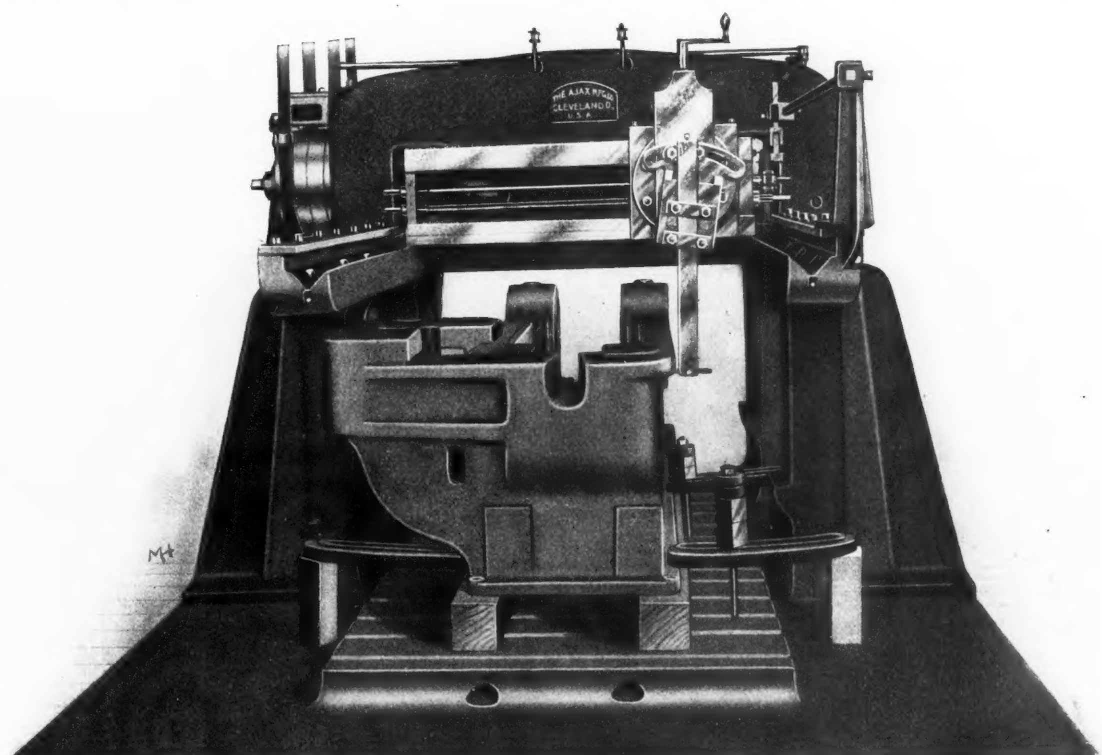


Electrically-driven Power Press.

gravity releasing type and gives unusually satisfactory results. The pattern for this press, with modifications in bed area, width, height, etc., can be made to suit special requirements. An automatic knock-out in the slide and automatic cam-actuated knock-out in the bed may be fitted to the press, if desired. Several sizes of this type of machine, equipped with motor drive, are manufactured.

## HEAVY PLANER OF NEW DESIGN.

The Ajax Mfg. Co., Cleveland, O., have developed, as a result of the needs of their business, a special type of planing machine designed for heavy work which they have now placed on the market in sizes ranging from 48 inches to 144 inches in width and of any desired length and height. The design of this planer is clearly indicated by the engravings on this and the next page. Unlike the usual type of planer the work in this case remains stationary and the tool travels. The casting to be planed is bolted to a massive bedplate and a wide slide carries the cross-rail planer head and tool back and forth over the work, the design of the slide being in effect an extension of the principle used in the operation of the ram of a shaper. The slide in this case is carried by V-guides supported by uprights which are bolted to the bedplate, and these uprights are stiffened by an arch-shaped casting of box section passing up over the slide and connecting the main upright of one side with the corresponding upright on the other side. Obviously, with a planer of this type the cross rail cannot be fed down to the work, and consequently where castings of different heights are to be machined they must either be blocked up on the bedplate or else, if the variation in height is not great, dependence must be placed upon the use of tool bars of different lengths. It is this feature which constitutes the special nature of the tool and makes it less easily adapted to work of varying heights than a standard type planer. On the other hand it has certain features of its own which make it a particularly useful machine in every way, especially where a large quantity of a certain class of work is to be turned out. Inasmuch as the slide or ram weighs considerably less than the table of an ordinary planer together with the casting being machined, it is possible to secure an unusually quick travel, reverse and return. In other words, the slide can be handled with great facility at a high rate of cutting speed. In the machine shown the speed of the cutting tool is 40 feet per minute, the speed of the belt on the cutting stroke is 1,019 feet per minute, and the return 45 feet per minute with a belt speed of 1,148 feet. The slide is driven by a gear running in a rack on top of the slide, the rack being 8½ inches wide and 2½ inches diametral pitch. The width of the driving belt is 3 inches and the maximum feed up and down is ⅛ inch, with side feed of ¼ inch, though this, of course, can be varied as desired. At a cutting speed of 40 feet per minute the planer can be reversed in a travel of less than 1 inch.



Special Planer for Heavy Work.

In Fig. 1 the planer is shown operating on a casting placed at the extreme end of the vees, and it will be evident that by locating the work in this position and allowing the ram to over-travel, pieces of any width can be machined which would

not pass between the uprights of a standard planer of corresponding size. We are informed that it is the intention of the builders to supply this machine in sizes to suit the special work that a firm may have to be done, and their experience with the original machine built for their own plant is that it is very satisfactory for work of such character.

with a speed box of geared friction type, giving four changes of speed, and operated by use of two levers. The frictions are of the double-band type, having few parts in their construction. The speed box can be easily interchanged with a cone by simply breaking a coupling connection on the lower driving shaft of the machine.

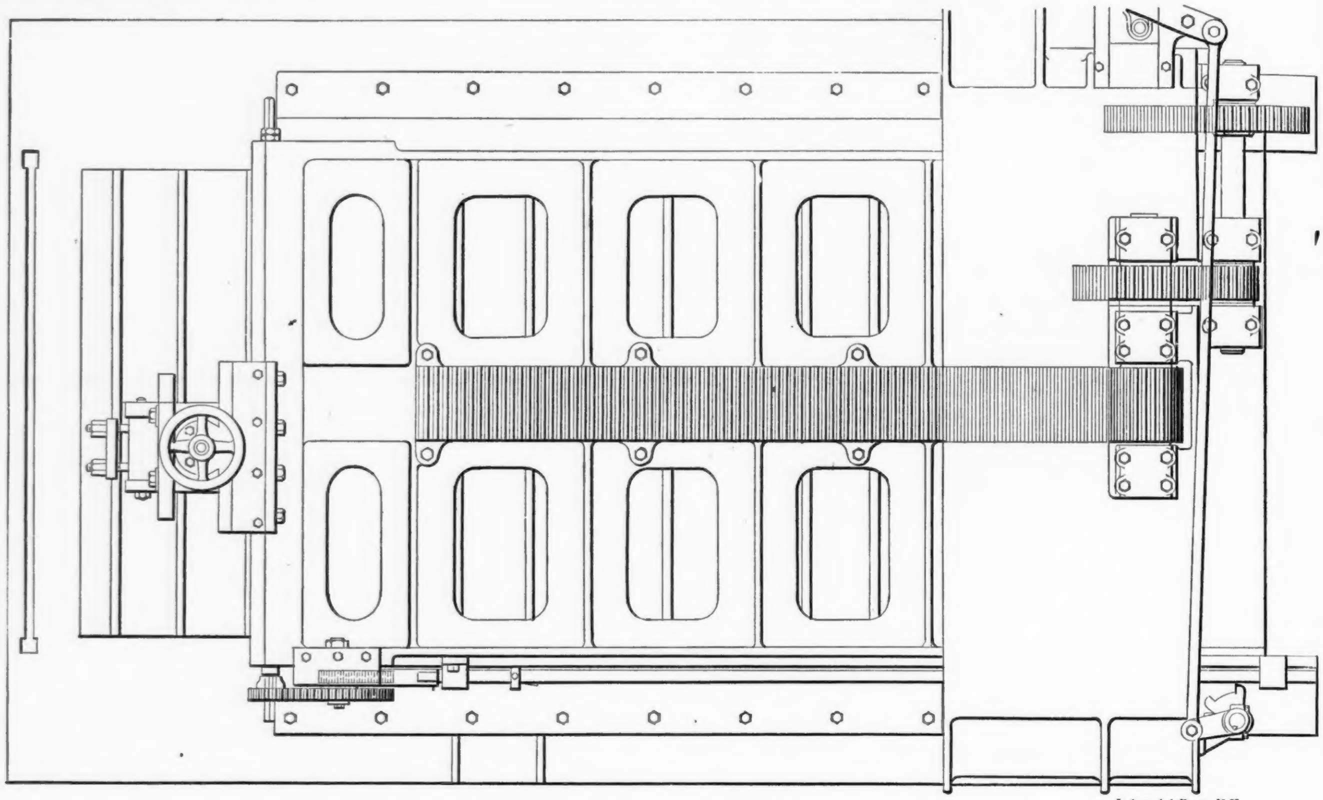



Fig. 2. Plan, showing Top of Slide and Rack Drive of Ajax Planer.

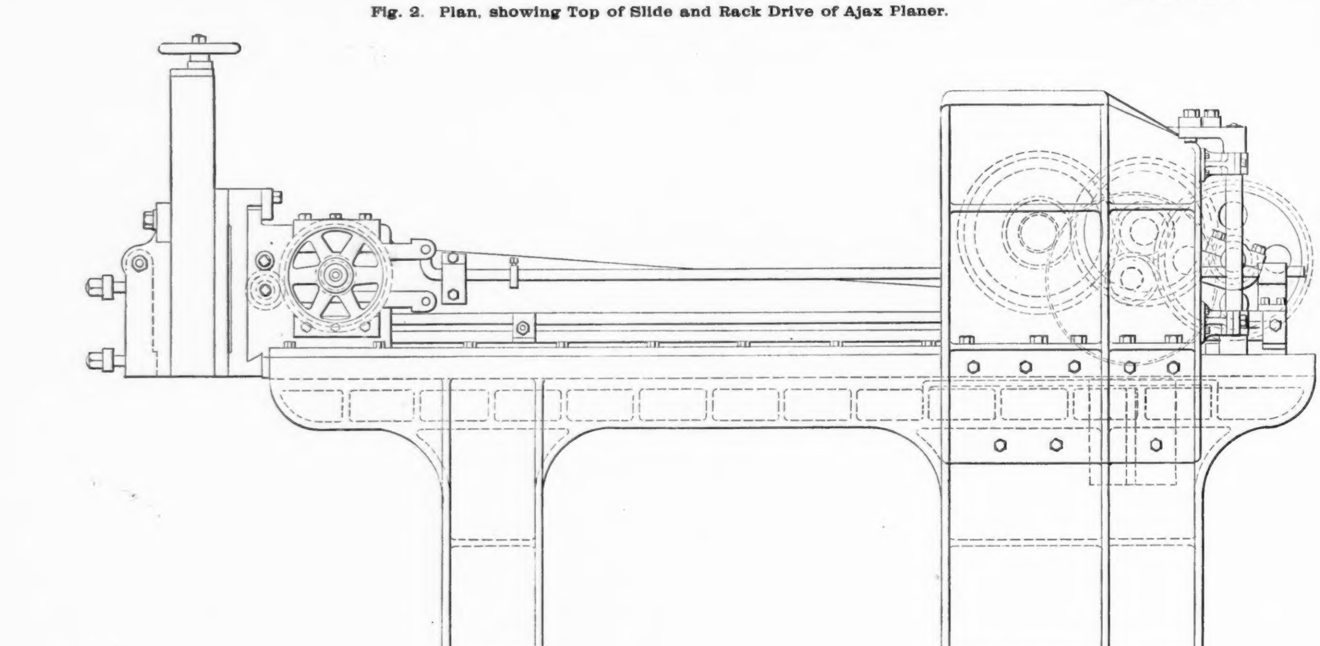



Fig. 3. Elevation, showing Side of Ajax Planer.

## RADIAL DRILL.

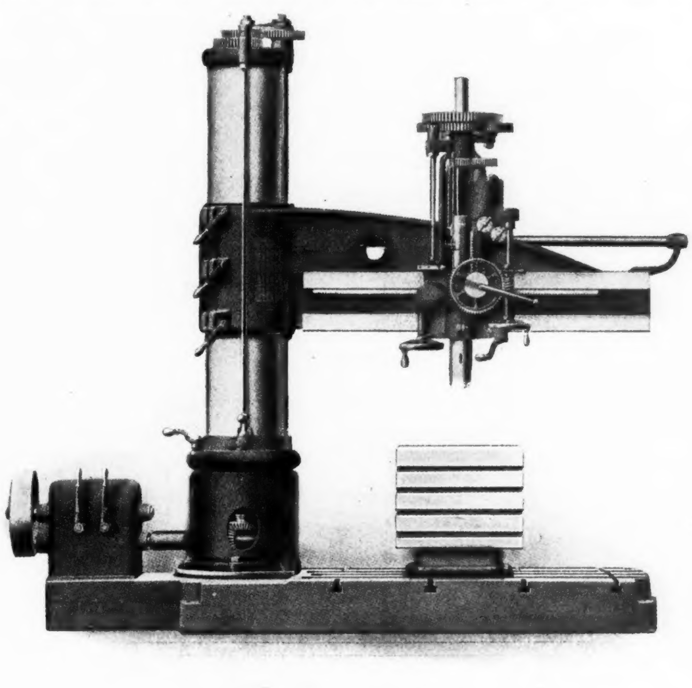
The American Tool Works Co., Cincinnati, O., have redesigned their line of radial drills, and the cut on following page shows their improved plain radial drill which can be furnished with 4, 5, 6, or 7-foot arms. The drill is fitted

The feed mechanism of the head is new. It provides eight rates of feed to the spindle, any one of which is obtained by a simple turning of a dial shown on the feed box until the desired feed is indexed thereon. This method requires no reference to index plates and subsequent handling of levers.

The feeds operate through a friction device which permits a drill to be crowded without straining the feed works. A plate is provided indicating twist drill sizes, and this in connection with the dial index, enables the operator to secure the proper feed for the drill he is using. The spindle is provided with trip mechanism.

There are sixteen changes of speed at the spindle—all available without stopping the machine. The column is of double tubular type, the inner column extending the entire height, and has full bearing for the outer column at both top and bottom. The arm is so designed as to have its under side parallel with the base.

A tapping mechanism is carried on the head, between the back gears and the speed box, thus placing the back-gear speed reduction between the friction drive and the tap, so as to provide ample power for heavy tapping. The taps are backed out at an accelerated speed. The lever for starting, stopping or reversing the spindle is at the head, and is controlled from the front.

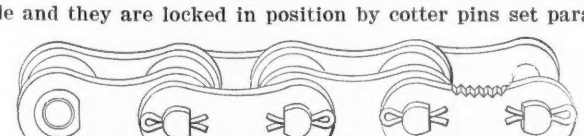


Radial Drill with Speed Box.

## WHITNEY DETACHABLE ROLLER CHAIN.

A new detachable roller chain for power transmission, especially on automobiles, has been brought out by the Whitney Mfg. Co., Hartford, Conn., and is shown in the accompanying illustration.

The links on one side of the chain are fitted tightly on the rivets and they are permanently secured by rivet heads in the same manner that links are held in ordinary riveted chains. All of the links on the opposite side of the chain are detachable and they are locked in position by cotter pins set parallel with the long diameter of the link. These detachable links are fitted tightly on the rivets with exception of one, which is called the connecting link, and this has notches in the top surface to distinguish it from the others. This special connecting link may be removed by the fingers after the cotter pins have been withdrawn.

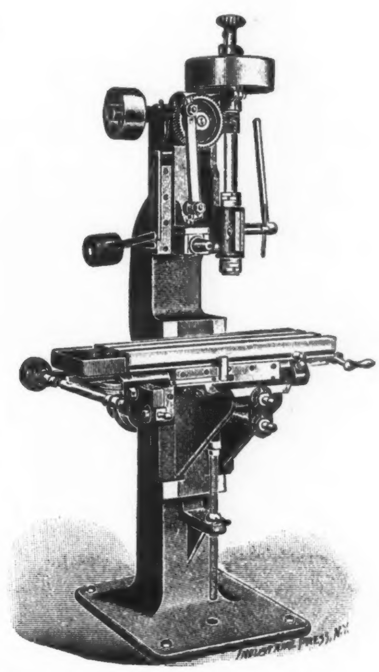


Industrial Press, N.Y.

The advantages claimed for this combination are therefore as follows: The cotter pins set parallel with the long diameter of the link instead of at right angles, are out of the way, even though they may be longer than necessary. All of the detachable links, except the special notched connecting link, are forced tightly onto the rivets, and are therefore practically as secure as the links on the opposite or riveted side of the chain. The rivet heads on the riveted side of the chain do not project far beyond the surface of the side plates, and the chain can therefore be used on certain automobiles and machines where there is little space for chain clearance. The rivets are flattened on one side, where they pass through the side plates, and so cannot turn in the side plates. The chain is so extremely simple that it may easily be understood by any operator without an explanation.

## MILLING MACHINE AND SLOTTER.

A vertical milling machine with slotting attachment has been brought out by R. M. Clough, Tolland, Conn. The table is 28 inches long, 9¾ inches wide, and has a longitudinal feed of 21 inches, a cross feed of 9 inches and a vertical feed of 15 inches. The cross and vertical screws have graduated dials. The spindle has a taper bearing 7 inches long at its lower end and is 1⅞ inches in diameter. Driving pulleys of 8 or 10 inches in diameter, with 2¾-inch belt, are furnished.



Vertical Milling Machine with Slotting Attachment.

The slotting attachment is bolted to the side of the head and also to the top of the machine. The slide is 12 inches long, running in bearings 10 inches long, and has a stroke of 4¾ inches. The slide is driven by a hardened tool-steel worm running in a bronze gear, and can be set to plane at an angle of 5 degrees or less in either direction, if desired. The gear can be thrown in or out of mesh with the worm by a movement of the lever. The tool post of the slotting attachment will take a tool ⅝ inch by 1 inch, and has a relief motion on the up stroke. The tool post can be swiveled so as to cut either lengthwise or cross-wise of the table. The slide is balanced by a movable weight.

## ATTACHMENT FOR MONITOR LATHES.

The construction of the Cahill lathe, made by P. J. Cahill, Leeds, Mass., and shown in Fig. 1, is such that it is unnecessary to stop the spindle to remove or insert the work. The features of the lathe are the style of chucks used for holding work and the method of opening and closing the jaws while the spindle is in motion.

Fig. 2 is an outline drawing of one of the chucks. It consists of an inner shell *B*, slotted at one end to receive the jaws *A*, and bored out and threaded at the other end to fit the nose of the lathe spindle. Outside of this inner shell *B* is an outer shell *C*, held in place on the inner shell by the nut *D*. The jaws are always held in the same position longitudinally by means of a bar *E* which screws to a bar extending through the lathe spindle, and is held at the rear end against a fixed stop. The advantage of this is obvious; it makes possible the use of cross-motion cutters and stops which would otherwise

be almost useless owing to the variation in the size of castings which would bring the jaws in different positions at different times.

The jaws are opened or closed by an endwise motion of the lathe spindle which slides the outer shell *C* longitudinally—the jaws, as stated, remaining in a fixed position. The

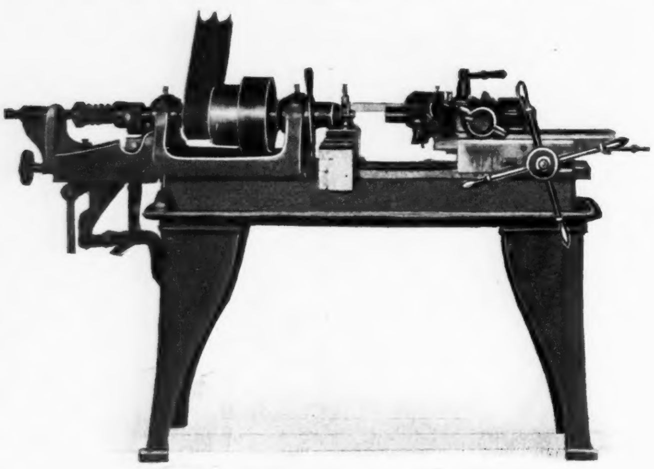
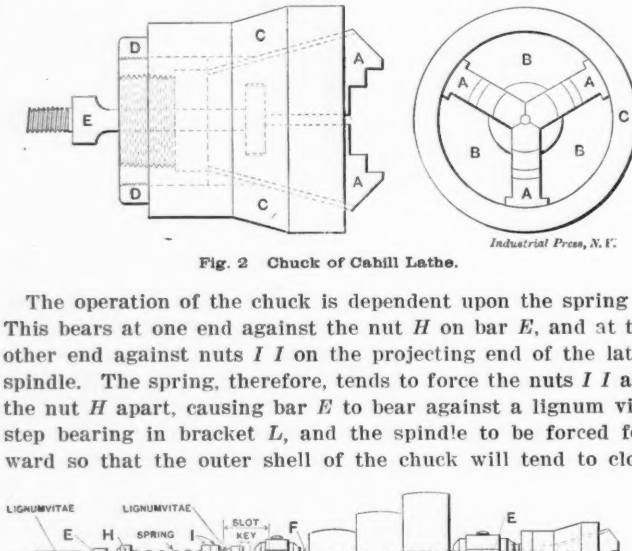


**Fig. 1. Monitor Lathe with Cahill Attachment.**

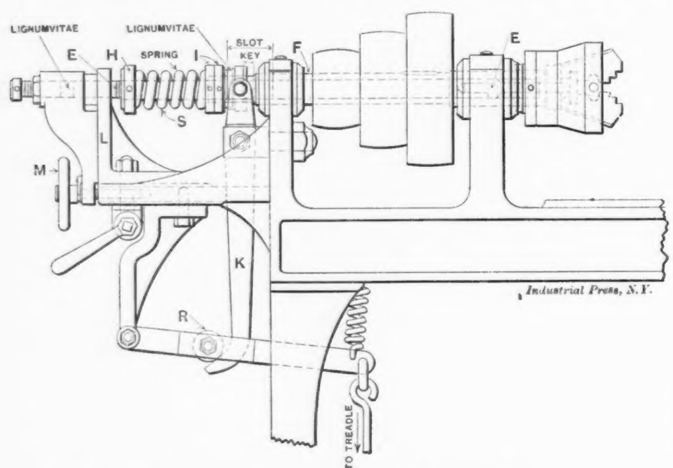
mechanism by which these results are accomplished will be clear from Fig. 3. The lathe is of the usual monitor type, except that there is a shelf extending to the rear of the headstock, on which is the sliding bracket *L* provided with a bearing at its upper end, for the reception of bar *E*, which extends through the hollow lathe spindle and connects with the jaws of the chuck.




*Industrial Press, N.Y.*

**Fig. 2 Chuck of Cahill Lathe.**

The operation of the chuck is dependent upon the spring *S*. This bears at one end against the nut *H* on bar *E*, and at the other end against nuts *I I* on the projecting end of the lathe spindle. The spring, therefore, tends to force the nuts *I I* and the nut *H* apart, causing bar *E* to bear against a lignum vitæ step bearing in bracket *L*, and the spindle to be forced forward so that the outer shell of the chuck will tend to close



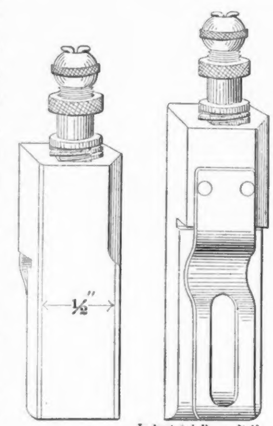

*Industrial Press, N.Y.*

**Fig. 3. Mechanism Operating Chuck of Cahill Lathe.**

the jaws. By means of handwheel *M* the location of the step bearing can be changed, and as this also determines the position of the chuck jaws, the adjustment of handwheel *M* will cause the jaws to open a greater or less amount, as required. The tension of spring *S* can be adjusted so that the pressure of the jaws may be made as light as desired, or as great as 4,000 pounds. A treadle is used to open the jaws by the connection shown, consisting of lever *K*, which is connected by a cam roll *R* attached to a lever connecting with the treadle. The operation of the machine needs no explanation, as it is used in the same manner and for the same purpose as any monitor. Any type of chuck may be used by suitable modification, and the design is well adapted for spring chucks as well as for the type shown. The device can be attached to any monitor lathe by simply bolting the shelf to the rear of the headstock and adding the necessary attachment.

## UNIVERSAL RULE SLIDE.

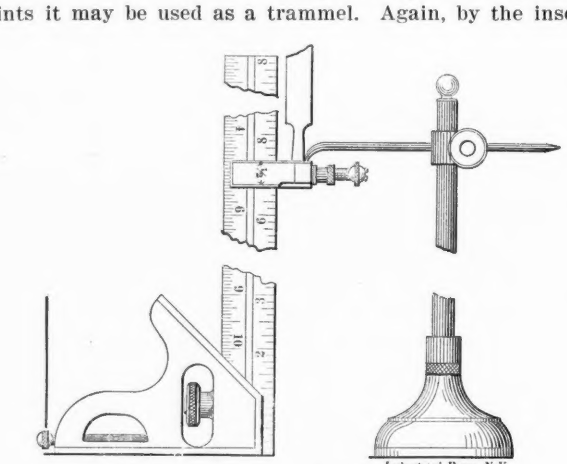
Mr. Robert A. Lachmann, a contributor to MACHINERY, has patented a universal rule slide for machinists' use which is manufactured by the Union Tool Mfg. Co., Chicago, Ill. This little slide, illustrated in Fig. 1, consists of an accurately constructed block cut out so as to form a shoulder to fit against the edge of a steel rule, and of a clamping device for holding it rigidly against this edge. An adjustable screw passes lengthwise through the block, and has a hook at its lower end by means of which the rule can be drawn against the shoulder. There is, in addition, a spring clip bearing against the side of the rule which produces enough friction to hold the slide in position, when the screw is loosened, and releases the hook. There is a hole through the screw for the reception of needle points, caliper points, pencil leads, etc., and the end of the screw is split so as to form a spring chuck for retaining these.




*Industrial Press, N.Y.*

**Lachmann's Rule Slide.**

An attractive circular is issued showing the large number of uses to which these little devices can be put. In sketch on next page is shown how it can be used for setting dividers or calipers. By its use the setting of calipers from the end of the rule, which frequently has round corners, is avoided; and where the rule has fine graduations only a short distance from the ends, the slide is particularly useful in setting the calipers, as will be evident from sketch. Where a pair of slides is used on a scale the scale is converted into a caliper square for either outside or inside measurements, and by inserting suitable points it may be used as a trammel. Again, by the insertion

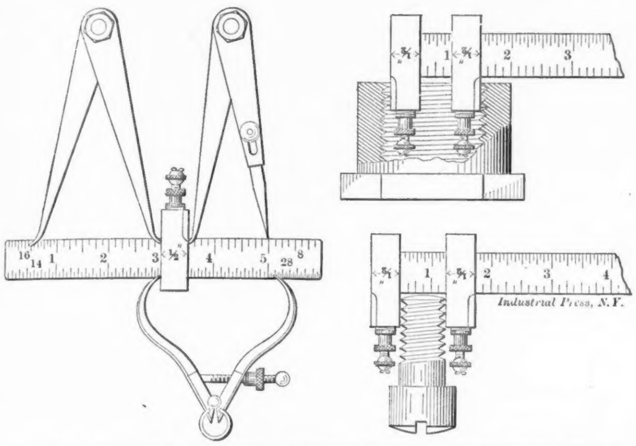


*Industrial Press, N.Y.*

**Application of Slide to Combination Square.**

of a steel needle in one slide and a pump center in the other, it is adapted for laying out other classes of work. Attached to the blade of a square, and with a straight point inserted, it is useful as a height gage; and if the blade of the square is graduated, as in the case of a combination square, it is adapted for setting a planer tool or surface gage. Provision is also made for using it as a depth gage.

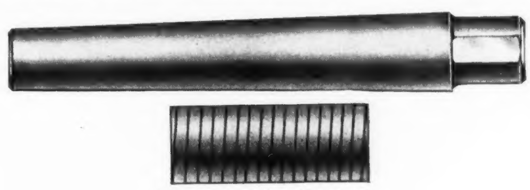
It is made in five sizes, and while it is not feasible to describe in these columns the many ingenious uses to which Mr. Lachmann applies his slide, these are fully explained in the circular.




Using the Rule Slide for Setting Calipers and also for Calipering Work.

### THE RICH EXPANDING MANDREL.

The taper arbor and spiral spring bushing fitting thereon, shown in the cut, forms an expanding mandrel, which is made by the Geo. R. Rich Manufacturing Co., Chicago, Ill., in sizes to accommodate diameters from 1 inch to 7 inches, inclusive. The taper arbor is made of tool steel, hardened and ground; the bushing is made of spring steel, wound in a close spiral

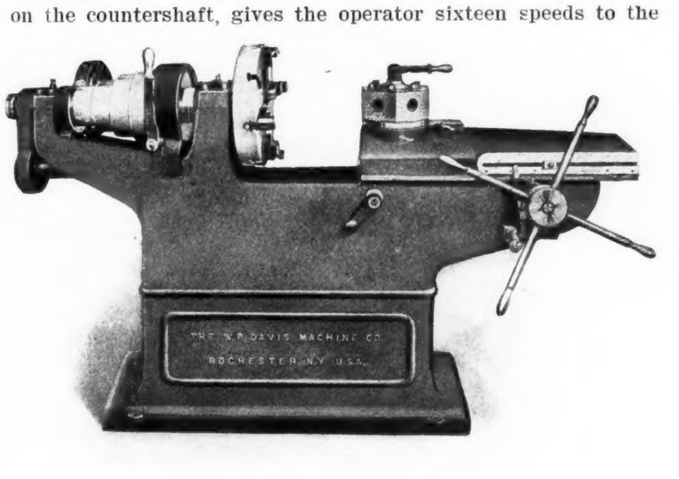


Rich Expanding Mandrel.

and tempered. Both the inner and outer surfaces are accurately ground. It is pointed out that these mandrels are particularly adapted to chucking light work or pieces having thin sections, as there is no distortion or scoring, the spiral bushing expands uniformly and fits a bored hole throughout. A complete set comprises 16 taper arbors and 28 bushings—special sizes are made to order.

### FRICTION HEAD TURRET BORING LATHE.

The cut herewith gives a very good idea of a turret boring lathe which has just been brought out to meet the requirements of the average machine shop. This lathe, being built to be used as a boring lathe only, embodies many features not found in the average boring lathe. This machine has a friction head which, with the use of the two driving pulleys on the countershaft, gives the operator sixteen speeds to the




Davis Turret Boring Lathe.

spindle. The lathe is also provided with quick change feed which can be used if desired while the lathe is in operation, giving every desirable feed that is required.

There is a power feed with automatic stop and the turret is provided with six holes for tools and is also accurately faced on the six sides so that special forming tools can be attached if desired. The lathe is furnished with center rest, or tool rest, which supports the tool close to the work, but is not shown in the cut; and it is also provided with countershaft with two friction drive pulleys. It swings 24 inches. This machine is made by The W. P. Davis Machine Co., Rochester, N. Y.

### A CUT-METER.

The Warner Instrument Co., Beloit, Wis., have placed an instrument on the market which is designed to fill a want of the high-speed steel user and which apparently will be very useful. It is called the cut-meter, and it is intended to show at a glance the speed at which work is running in the lathe or on the planer, or the peripheral speed of milling cutters. The speed is shown directly by the reading of the graduated scale without having to use a watch for timing, as is the case with the ordinary speed indicator. The graduations read in feet per minute traveled by the circumference of the wheel instead of in revolutions per minute, as usual. There is a rubber-tired disk on a shaft projecting from the instrument, and, to determine the speed, it is only necessary to hold the edge of this disk against the rotating piece and read the graduation. The rotation of the disk revolves a permanent magnet within the casing, and the lines of magnetic force transmitted through a thin aluminum disk to a soft steel ring behind it, tend to drag the aluminum disk around with the rotating magnet. But the rotation of the aluminum disk is resisted by a carefully calibrated hair-spring; therefore, its angular displacement is made proportional to the speed of rotation of the rubber-tired wheel pressed against the work. The displacement of the aluminum disk is indicated by a scale and pointer under a transparent cover through which the readings in feet per minute can be observed. The friction wheel shaft is mounted in ball bearings and the aluminum disk is mounted on hardened steel pivots working in sapphire bearings, the combination being designed to indicate readings with very little frictional resistance to the work and to be easily held in the hand.

### GRINDING MACHINE.

A machine designed for straight, cylindrical and taper grinding has been brought out by the Diamond Machine Co., Providence, R. I. It is constructed in the most simple form possible, with a view to adapting it strictly to the class of work for which it was designed. A former is provided, by the use of which short abrupt tapers can be ground at any point in the length of the piece being finished. The base is unusually heavy, and the machine will take work 5 feet between centers.

* * *

## PRESSED STEEL HANGER.

Fig. 1 herewith shows the 4-way adjustment pattern of the "American Pioneer" shaft hanger which is made of pressed steel by the Standard Pressed Steel Co., Philadelphia, Pa. It consists of two pressed steel legs, each strongly ribbed and

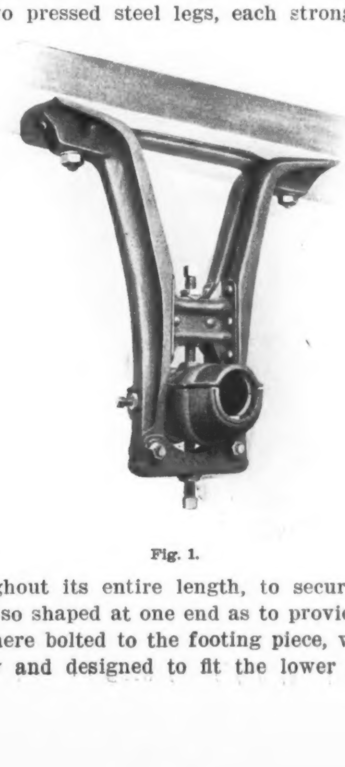


Fig. 1.

flanged throughout its entire length, to secure rigidity and lightness, and so shaped at one end as to provide a broad and strong foot where bolted to the footing piece, while the other end is narrow and designed to fit the lower cross piece or

clamp, as shown. A flanged and corrugated plate of pressed steel connects the two feet and is riveted to them. The brace connecting the upper part of the parallel portion of the legs is also of pressed steel and riveted in place. This part not only acts as a brace but also takes the thrust of one of the vertical adjusting screws for the bearing. The lower vertical adjusting screw is supported by the clamp at the small end of the hanger, and by removing one of the two bolts which holds the clamp in position the latter may be swung out of the way, allowing the bearing to be dropped down and out of the hanger, which is often more convenient than sliding it endwise.

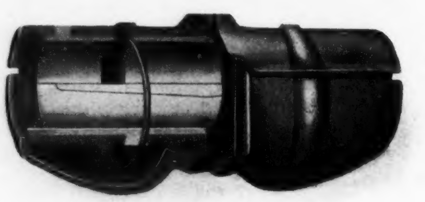
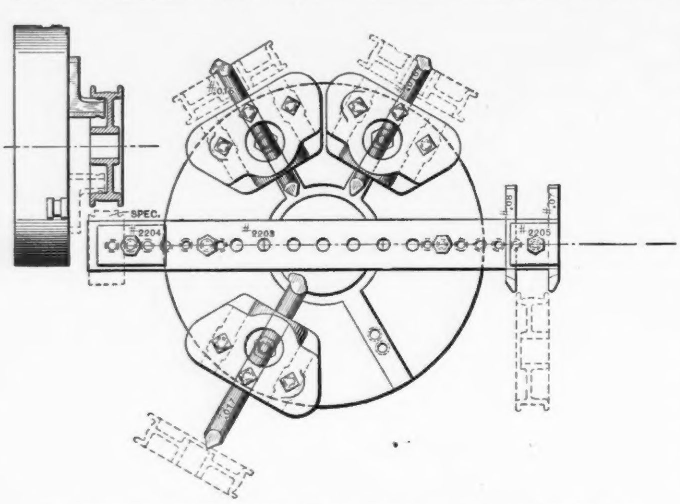


Fig. 2.

Special attention has also been given to the design of the bearing itself, as it was desired that it combine the advantages of the ball-and-socket principle with those of the 4-way adjustment.

The bearing consists of three parts: An upper and a lower half bearing and an oil pan, all made of cast iron—on the top of the upper and on the bottom of the lower; these half bearings are fitted with spheres having their common center in the center of axis of bearing. A socket of the same radius as that of the spheres is fitted centrally on the inside and in the bottom of the oil pan, which is made large enough to keep sufficient oil for lubrication, and at the same time to accommodate the lower half bearing, while a recess located centrally on the outside of the oil pan is provided for the lower adjusting screw. Thus when the complete bearing is



The Operations of Machining a Flange Pulley on the Flat Turret Lathe.

put together and fitted between the adjusting screws, the two half bearings which bear on each other their full length, are supported on the socket in the bottom of the oil pan, and as plenty of clearance has purposely been provided between this and the half bearings wherever necessary to insure independent motion, these are left free to adjust themselves to fit the shaft, while the oil pan remains *stationary*, being firmly held by two horizontal and one vertical adjusting screw. The vertical adjusting screws are fitted in slotted holes, and can therefore, besides providing for liberal vertical also allow ample side adjustment—this latter being determined by the horizontal adjusting screws. To prevent the objectionable dripping of oil, automatic wipers have been fitted. The bearing is designed for ring oiling—the rings being of tempered spring steel, and will retain their original circular shape, thus insuring reliable and continuous lubrication. In case any other method of lubrication is desired it can be provided.

The proportion of this hanger have been carefully computed, and while it is much lighter than a cast-iron hanger, it is very much stronger, easier to erect and neater in appearance. The results of tests made by the Riehle Bros. Testing Machine Co. upon a cast-iron shaft hanger and a pressed steel shaft hanger have been sent us by the Standard Pressed Steel Co., and are as follows:

Cast-iron Hanger.

| Load in pounds. | Deflection in inches. | Permanent set in inches. |
|---|---|---|
| 200 | .010 | |
| 500 | .029 | |
| 1,000 | .073 | .024 |
| 1,500 | .115 | .037 |
| 2,000 | .147 | .048 |
| 2,500 | .193 | .06 |
| 3,000 | .254 | .085 |
| 3,500 | .353 | .133 |

After applying 3,500 pounds and observing deflection and set, the load was again applied to the hanger, the tension leg breaking when load of 3,500 pounds was reached.

Pressed Steel Hanger.

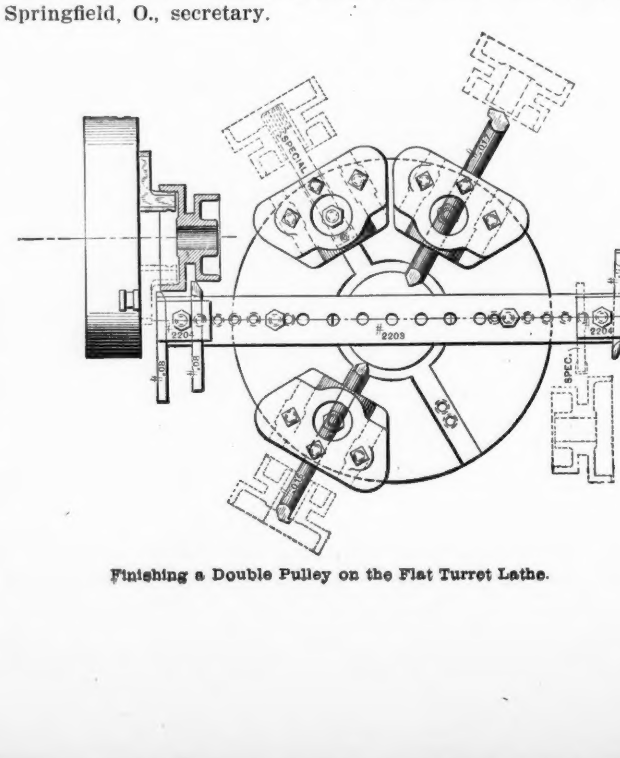
| Load in pounds. | Deflection in inches | Permanent set in inches. |
|---|---|---|
| 200 | .0035 | |
| 500 | .012 | |
| 1,000 | .030 | .003 |
| 1,500 | .060 | .02 |
| 2,000 | .087 | .028 |
| 2,500 | .116 | .038 |
| 3,000 | .144 | .056 |
| 3,500 | .181 | .074 |
| 4,000 | .238 | .110 |
| 5,000 | .497 | .299 |

After 5,000 pounds readings of deflection and set were not taken and the load was continued up to 7,160 pounds.

* * *

## MEETING OF THE MACHINE TOOL BUILDERS' ASSOCIATION.

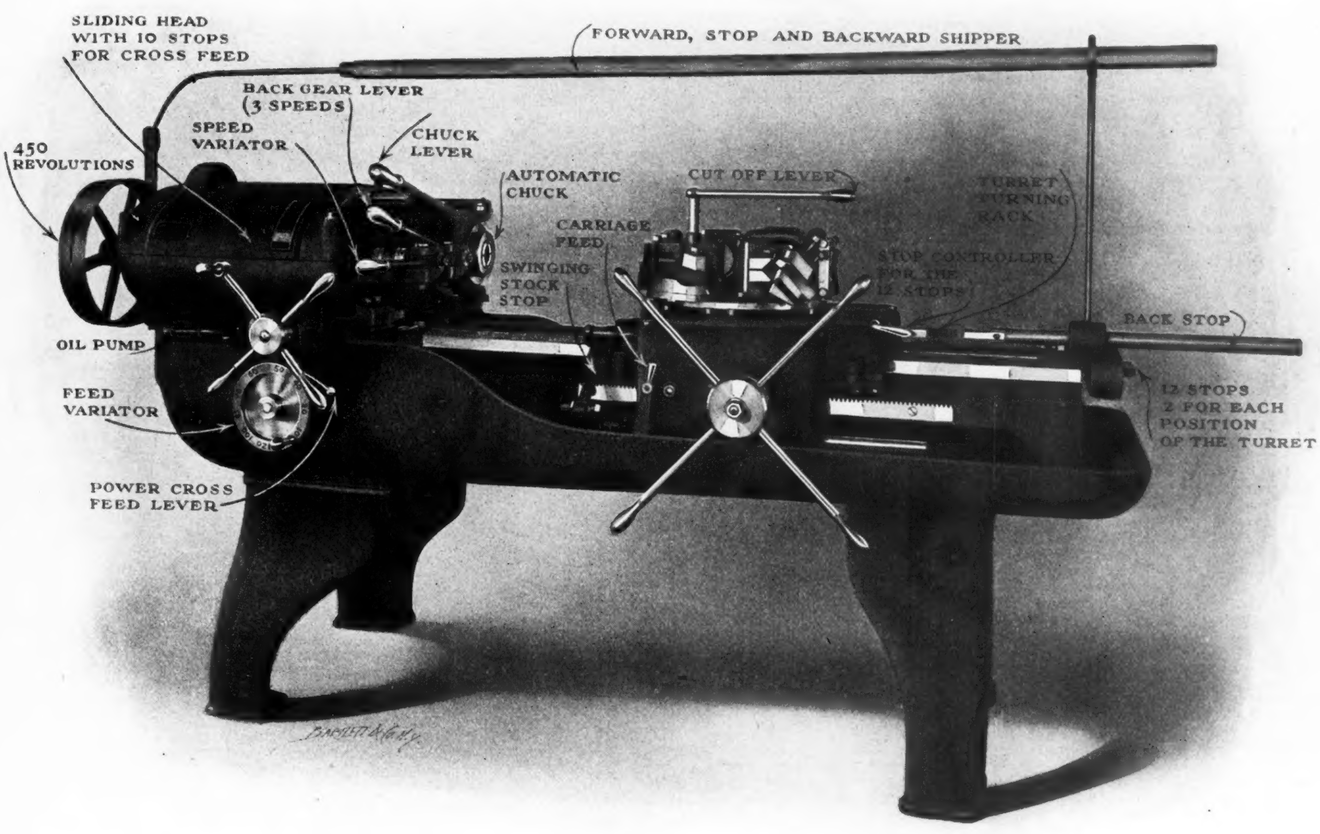
On Tuesday and Wednesday, April 26 and 27, the National Machine Tool Builders' Association held their semi-annual meeting at the Grand Hotel, in Cincinnati. The first session on Tuesday was devoted to the roll call, the reading of minutes, selection of convention committees, reports of standing committees, and other business matters. The following sessions were devoted to new and unfinished business and to the presentation of papers and their discussion. P. E. Montanus, secretary, gave an address in which he showed the work that had been done by the association of machine tool builders, and in which he presented strong arguments for belonging to the association. It is interesting to mention in this connection that Mr. Montanus has the honor of being the nominee as candidate for Congress from the Seventh Congressional District of Ohio, on the democratic ticket. Mr. Fred L. Eberhardt discussed the present status of the shaper trade, and Mr. A. F. Tuechter, the condition of the upright drill trade. The officers of the Association are: Wm. Lodge, of Cincinnati, president; W. P. Davis, Rochester, N. Y., first vice-president; F. E. Reed, Worcester, Mass., second vice-president; Enoch Earle, Worcester, Mass., treasurer, and P. E. Montanus, Springfield, O., secretary.



Finishing a Double Pulley on the Flat Turret Lathe.

## NEW FLAT TURRET LATHE.*

The Jones & Lamson Machine Co., Springfield, Vt., have adhered to their policy of producing one style of machine for so many years that a new flat turret lathe, of which an illustration is shown herewith, will attract more than usual attention. This lathe is the result of extended experimental work, with a view to increasing the utility of this type of machine, and making it in every way adapted to the increasing demands of modern practice. The lathe is made in two sizes—called the 2 x 24 and the 3 x 36 sizes—and is designed not only for operating upon bar stock, but for machining pieces held in the chuck, up to 12 inches diameter in the smaller lathe and 14 inches diameter in the larger one. As heretofore, tools are supplied for machining almost any shape of work, and the old claim is maintained that single pieces can be finished in a shorter time on this machine than in an engine lathe, and also by the aid of the stops with which the different feeds are provided work can be turned out in quantity in the most economical manner.




Flat Turret Lathe—Operates on Castings and Forgings as well as on Bar Stock.

A glance at the view of the machine will show that the greatest changes have been made in the head and bed, while the turret is substantially as heretofore, although this, too, has been changed in some particulars. Aside from the general appearance of the machine the most important changes in its design are as follows:

1. Power is received on a single pulley, and the spindle is driven by a gear mechanism enclosed in the head, through which all the changes in both directions are obtained. The headstock which encloses this gear mechanism is in the form of a shallow pan in which a supply of oil reaches the lower half of the running parts, and the same scheme also provides for the lubrication of the main bearings of the spindle. The entire mechanism is covered by a cast-iron hood.

2. In order to adapt the machine to operating on work held in the chuck the headstock is mounted on guide ways running across the machine, making it possible to give the work a cross feed relative to each tool on the turret. Absolute return of the spindle to its central position is assured, by giving the head travel in one direction only and bringing it against a positive stop in the opposite direction.

3. The machine is provided with variable longitudinal and cross feeds by mechanism similar to that employed for the variable speeds of the spindle.

4. The feed mechanism is such that the feed pulls the carriage, or head, as the case may be, with a maximum pressure solidly against a positive feed stop and holds it there under strong pressure until disengaged by the operator. Heretofore the stop mechanism for the feeds would throw out the feed just before the tool reached the desired point, and it was not possible to bring the tool to precisely the same point successively on different pieces. This is a decided improvement in the production of accurate duplicate work.

5. Twelve stops are now provided for the turret instead of six, making two for each tool, and the cross feed for the head is provided with ten stops.

6. In the matter of lubrication, the jointed pipes heretofore employed are no longer required, the oil being delivered to a pipe connected to the under side of the turret carriage, from whence the oil passes up through the turner that is in working position and comes out above the cutting tool in a steady stream.

In the tool equipment the regular turners and other tools, such as were employed on the older machines for bar work, are used on this machine, and in addition there is a simple equipment of turning and boring tools adapted for almost any class of work held in the chuck. The method of using these tools will be evident from the illustrations on the previous page, where the rotation of the turret is indicated by the dotted lines showing the work in the successive positions it would occupy relative to the various tools. What this machine therefore provides is self-contained variable speeds and feeds, 22 positive stops for the work and tools together, and an equipment of simple but universal tools.

* * *

The date of the first telegram received in Chicago and of the first railway train to run over a track within its limits is 1848.

* The illustrations are from the new catalogue of the lathe, about to be issued.

## FRESH FROM THE PRESS.

COMMUTATOR CONSTRUCTION, by William Baxter, Jr., is the third of the series of little pamphlets which are being published by the Derry-Collard Co. at 25 cents each. These may be called single-topic pamphlets or monographs, each dealing with one subject in a simple manner.

THE INDUSTRIAL PUBLICATION CO., 16 Thomas St., New York, have sent us several copies of their books for woodworkers, carpenters and architects, most of which sell at from 50 cents to $1.00 each. One of these is a series of questions and answers upon the principles and progress of architecture; another pertains to practical carpentry, and a third to estimating the cost of wood work.

ENGINEERS' ARITHMETIC. By Fred H. Colvin and Walter Lee Cheney. Published by the Derry-Collard Co., 256 Broadway, New York. Price 50 cents.

*Machine Shop Arithmetic*, by Colvin & Cheney, is well known to a large number of the readers of MACHINERY, and it has been one of the most popular books published for those in the machine shop. *The Engineers' Arithmetic* contains such of the matter of the first-mentioned book as is of use to the engineer and, in addition, a discussion of the principles used in calculations that an engineer should know how to make. A brief glossary of terms is also given.

THE FACTORY MANAGER AND ACCOUNTANT. By Horace L. Arnold. Published by the Engineering Magazine Co., 120 Liberty St., New York. 432 pages. Illustrated. Price $5.00.

The former work by Mr. Arnold—the *Complete Cost Keeper*—has been considered one of the most important treatises on cost keeping that has been published. The new volume is somewhat different in its scope, being composed entirely of descriptions of systems in actual use in a number of manufacturing plants. There are nine of these systems described in detail. All blanks and forms referred to in the text are reproduced, each one having its size given, together with the color and kind of paper on which it is printed. The aim is to explain the methods of successful factory managers in such a way that anyone can estimate the value of the system for his own use.

*The Technical World* is the title of an attractive monthly periodical that is now being published by the American School of Correspondence, at Armour Institute of Technology, Chicago, Ill. It is a journal about the size of the average 10-cent popular magazine, and each issue covers some of the interesting subjects occurring month by month in the technical field. All the articles are written in a popular style, adapting them to the general reader, and while most of the articles are of a descriptive nature, there are a few in each issue which may be classed as educational. There is a department reviewing current technical literature, and one containing questions and answers. The magazine was started primarily for the benefit of the students of the American School of Correspondence, but it is as well adapted to the general reader as to the students of this school.

THE POLAR PLANIMETER. By J. Y. Wheatley, C. E. Published by Keuffel & Esser, New York. 114 pages, with several folding charts. Illustrated. Price $3.00.

In explanation of this book the author says that he once placed an order for a planimeter and, having read the directions for use furnished by the maker, was not satisfied with them and wrote the firm asking for the best treatise on the subject, to give him the information necessary to make an intelligent use of the instrument. The reply was that no such treatise was published, and this led him to study up the subject. He first took up the theory of the planimeter and then considered the numerous engineering problems by which that theory could be applied. This book is the result of his labors. The author believes that the planimeter is of far greater value as an aid in engineering calculations than has been supposed. The chapters, besides containing descriptive matter and dealing with theory, consider the measurements of areas; problems involving average; and measures of quantities of materials—this latter being treated very fully and including many applications of the instrument that the average user of the planimeter has probably not thought of.

CHANGE GEAR DEVICES. Oscar E. Perrigo. Published by the Derry-Collard Co., 256 Broadway, New York. 81 pages. Illustrated. Price $1.00.

Some time ago the author of this book had occasion to make a careful examination of the subject of change gear devices for engine lathes. From among the United States patents on such devices he finally selected twenty-nine that appeared to him to be of the greatest importance in the development of this part of the mechanism of the engine lathe. Drawings were prepared from these twenty-nine patents and a description of each was written, forming a series of articles that was later published in MACHINERY. These articles attracted wide attention, because at the present time nearly all the machine tool builders have either adopted, or are considering the adoption of some form of gear feed mechanism by which a positive and easily changed feed can be obtained. This book contains the articles published in MACHINERY, with some additions and revisions. While the devices illustrated pertain mainly to those used in connection with screw cutting, most of them are capable of use also as regular feed mechanism on lathes or other tools.

THE METRIC FALLACY. By Fred A. Halsey and Samuel S. Dale. Published by the D. Van Nostrand Co., 23 Murray and 27 Warren Sts., New York. Price, $1.00.

Mr. Halsey's strenuous efforts to avert the metric calamity which he and many others believe has hung over this country like a threatening cloud, have attracted almost universal attention in the industrial world. This book is the outgrowth of his paper upon the subject presented to the American Society of Mechanical Engineers, but contains numerous additions and data more lately secured, and also an extensive treatment of the questions as related to the textile industries, by Mr. Dale. This volume contains the greatest mass of information and argument in favor of retaining the English system of units that has probably ever been gotten together by all other writers combined. While we think the metric danger may have been somewhat overestimated, we are opposed to the introduction of the metric system in machine shop practice, and the reading of this book will tend to allay any doubts one may have as to the advisability of retaining our system of English units, imperfect as it is.

THE STEAM TURBINE. By Robert Neilson. Published by Longmans, Green & Co., London and New York. Second edition. 294 pages. Illustrated. Price $3.50.

The valuable feature of this book is a list of English patents on the turbine, down to the year 1902. From this list the author has selected such as seem to him to be of the greatest importance and he has published drawings and descriptions of these. The leading turbines of the day are described, and in the new edition additional matter is given upon the Stumpf, Schulz, Curtis, Seger, and other of the more recent machines. The theory of the steam turbine, including the flow of steam and the proportioning of the guide vanes and blades, is touched upon to a rather limited extent. There is one chapter upon the vanes and one short chapter upon the theory of the action of the steam. These two chapters could profitably be extended as they treat of the branches of the subject that most people are not familiar with, while the descriptive matter which is given, although carefully prepared, is much of it available elsewhere. We think the most valuable portion of the book is the historical review.

COMPENDIUM OF DRAWING. Published by the American School of Correspondence, at Armour Institute of Technology, Chicago, Ill., in two volumes. Illustrated. Special price until June 1st, $3.00 per volume, or $5.00 for both volumes.

Part I. takes up elementary drawing, projection, descriptive geometry, shades and shadows, perspective drawing, lettering (including architectural lettering) and free-hand sketching. Part II. treats of machine drawing, the elements of mechanism, the elements of machine design, and laying out sheet metal work. Both volumes are profusely illustrated, mainly with original engravings.

We have previously taken occasion to refer favorably to the instruction papers upon mechanical drawing issued by the American School of Correspondence. These two volumes contain the papers before mentioned and, in addition, several papers such as those on mechanism, free-hand drawing, lettering, sheet metal work, etc. The machine design and mechanical drawing papers are by Prof. Griffin who, as we have said, adopted an entirely original and, we believe, very practical plan—quite out of the ordinary—for teaching the subject. They also contain the excellent paper on perspective drawing by Wm. H. Lawrence, associate professor of architecture at Massachusetts Institute of Technology. One other paper is by Frank C. Brown, architect, Boston, and by Wm. Neubecker, instructor of the sheet metal department, New York Trade School. The balance are by Prof. Gardner and Instructors Gregg, Kenison and James, at Massachusetts Institute of Technology.

It will be seen from the foregoing list that the several papers have been prepared by men entirely competent to do the work well, and who have devoted particular attention to the subject upon which they write. In many respects, therefore, we think this compendium is of greater value than a text book written by one man, covering the same list of subjects. The only objection to such an arrangement is a possible lack of continuity, which, however, is not at all serious in this instance. We believe that the books will impress one, upon careful examination, as being well written, thorough and satisfactory.

## NEW TRADE LITERATURE.

**Manufacturers and others sending catalogues for notice are requested to address them to the Editor of MACHINERY, so that they can be kept separate from catalogues sent us for other purposes.**

THE BESSEMER GAS ENGINE CO., Grove City, Pa. Neat folder calling attention to the Bessemer gas engine oil.

THE LONDON MACHINE TOOL CO., London, Ont. Illustrated catalogue of planers and shapers. The planers are built in sizes from 20 to 72 inches, and the shapers from 16 to 24 inches.

THE HILL MACHINE CO., Anderson, Ind. Bulletin No. 2, which is intended as a supplement to their 1901 catalogue. It illustrates some of the pumping machinery which has been perfected since the issuance of their catalogue.

THE S. A. WOODS MACHINE CO., Boston, Mass. Folder containing an illustration and description of the company's No. 221 full automatic knife grinder, built to grind up to 42 inches in length. Their 222 grinds up to 78 inches.

THE AMERICAN TAP & DIE CO., Greenfield, Mass. Pocket size catalogue and discount sheet of machine screw taps, hand taps, nut taps, tapper taps, boiler taps, long and taper hob taps, short plug hob taps, pipe taps, pipe reamers, adjustable dies, etc.

THE W. J. CLARK CO., Salem, O. Pamphlets Nos. 5, 6 and 7 regarding the "Quick as Wink" couplers. The first of these deals with couplers of this type for air, steam or gas hose; the second, with couplers for water hose, and the third for fire hose.

THE R. A. KELLY CO., Xenia, O. Catalogue H of crank shapers. This line of shapers has been redesigned and the company here call attention to some of the new features. Single geared and back-geared shapers of different sizes are shown and described.

GEO. OWEN & CO., LTD., 95-97 Liberty Street, New York. Advertising matter regarding this company's "Red Cross" cement, for use in making screwed joints for steam, gas, water or air pipes. A leaflet describing the cement, a price list and a postal containing a trial offer have been issued.

THE NORTHERN ELECTRICAL MFG. CO., Madison, Wis. Bulletin No. 35 and a number of leaflets showing the application of the Northern motor to lathes, milling machines, grinders, turret lathes, boring mills and pumping machinery of prominent makes. The bulletin contains a full description of the "Northern" motor.

THE F. BISSELL CO., Toledo, O. Bulletins Nos. 36 and 37, the former illustrating and describing various kinds of batteries and battery supplies, and the latter presenting house goods, such as annunciators, call bells, buzzers, push buttons, speaking tubes, telegraph apparatus, etc. These bulletins will be sent prepaid on request.

THE GENERAL PNEUMATIC TOOL CO., Montour Falls, N. Y. Circular and leaflets of the products of this country. These include pneumatic tools, compression riveters, air compressors, cranes, etc. The circular shows a number of riveters at work, and one style of riveter whose stake may be swung in any direction and will operate on flanges standing in any position.

THE O. S. WALKER CO., Worcester, Mass. Illustrated catalogue of the Walker magnetic chucks, for use on surface grinders, iron planers or shapers, and for holding, without the use of bolts, straps or jaws, iron and steel parts of machines. The different types are: Flat chucks, tool room chucks, universal swiveling chucks, rotary chucks, all illustrated in the catalogue, and which are made in various sizes.

THE BROWN HOISTING MACHINERY CO., Cleveland, O. Illustrated booklet treating of "ferro-inclave." This new product, described in MACHINERY, October, 1903, issue, is for use in the construction of roofing, siding, flooring, etc. It consists of corrugated steel sheets made in dovetail form so that one sheet will shingle edgewise into the other. Over this is laid a covering of cement, which makes the construction strong, water-tight and durable.

THE CINCINNATI SHAPER CO., Cincinnati, O. Catalogue C, April, 1904, of shapers. These are shown in the following sizes: Crank shapers, 16, 20, 24, 26 and 30 inches; traverse shapers, with one or two heads, and single or back-geared, 18, 20, 24 and 36 inches. Several pages are devoted to the attachments used on these shapers; and crank shapers and traverse shapers equipped with electric drive also appear. The company call attention to their new shop, located at Elam St. and Garrard Ave., and present a fine half-tone view of same.

THE SCULLY IRON & STEEL CO., Chicago Ill. Illustrated pamphlet describing the Lovekin metal expanding tools. It is stated that these tools are based on an entirely new principle and have been designed for expanding and flanging pipe, from the smallest size boiler tube to the largest lap-welded piping made, and also for expanding valve seats, etc. The new method is the invention of L. D. Lovekin, and is fully treated in this pamphlet, which also contains a large number of drawings showing the features of the device.

THE S. OBERMAYER CO., Cincinnati O. General Catalogue No. 40. This is a cloth-covered book, containing 370 pages, and the company's announcement that it is intended to cover "everything you need in the foundry," appears a true one. The catalogue is very complete and com-

prehensive and will certainly prove most useful as a book of reference. Everything in the line of supplies for foundrymen's use is to be found here, with a very complete index to facilitate the finding of any special article in which one may be interested. Some dozen pages in the back contain useful tables and miscellaneous information of particular value to foundrymen.

The Modern Tool Co., Erie, Pa. Pamphlet illustrating and describing the patent chaser grinder; a tap and die holder; the "Magic" chuck and collets, for quickly changing drills, reamers, counterbores, taps, etc., without stopping the machine; the "Modern" tapping attachment and the "Star" tapping attachment. This latter device is designed for use on an upright drill and it drills or taps bottom holes and also "through" holes. It is especially useful for successive operations, such as drilling a hole, then tapping it and setting a stud in without moving the work.

The Hartford Blower Co., Hartford, Conn. Sectional catalogue No. 57, entitled "Dust Collecting." This treats of the Hartford adjustable exhaust fans which are built to be placed upright on the floor or on a suitable foundation, or bolted directly to overhead timbers; of automatic furnace feeders; cyclone dust collectors, etc. Several illustrations show the Hartford exhaust system applied in various plants. A number of testimonial letters reproduced in this catalogue contain expressions of the satisfaction derived from the use of the Hartford system. The company make a specialty of installing heating, ventilating and drying systems, also exhaust and blow-pipe systems, forced and induced draft systems, etc.

The E. W. Bliss Co., Brooklyn, N. Y. A treatise on power presses. Some varieties of the "Bliss" power presses for the production of sheet metal articles are illustrated. First the simple presses are shown and then the more elaborate forms and finally the entirely automatic machines. These tools are designed for a great variety of work, such as punching, stamping, drawing, blanking, embossing, riveting wiring, broaching, forming, trimming, bending and forging, etc., and are of the following types: Single-action, double and triple-action presses; double-crank, cam, knuckle joint, toggle and drop presses. Excellent views of the company's various departments are shown; and a fine map of the St. Louis Exposition grounds—the location of the "Bliss" exhibit being indicated by a star—is also given.

The Wells Bros. Co., Greenfield, Mass., have brought out a catalogue cabinet which they furnish to the hardware and machine tool dealers with a quantity of catalogues, free of charge. These catalogues show illustrations of their latest improvements in machinist tools and also a complete line of screw-cutting machinery such as bolt cutters, nut tappers, etc. The cabinet, illustrated herewith, is furnished to those who can make use of the number of catalogues that it contains, which is about forty.

### NILES-BEMENT-POND CATALOGUE.

The Niles-Bement-Pond Co., New York. Catalogue of machine tools. This volume contains 750 pages and is the most complete catalogue of the kind ever published. It opens with six full-page illustrations of the various works of the Niles-Bement-Pond Company, and following these are 13 pages of medals and diplomas awarded the various constituent companies of this concern, dating as far back as 1871, though the medals of the more recent expositions are much in the majority. The reproductions of the medals are particularly excellent. Then begins the main part of the catalogue. First are the machines for railroad shop use. These include a most complete line of driving wheel lathes. Fourteen different full-page illustrations are given of these machines, showing all sizes from 51-inch to 100-inch swing, and one or two special machines adapted particularly to the use of modern high power tool steels. The other railroad tools include three different styles of car-wheel lathes, a large variety of axle lathes, cutting-off and centering machines, quartering machines, car-wheel borers and hydrostatic wheel presses. The next division is devoted to lathes, including all sizes from the Pratt & Whitney bench lathe to the massive Bement 125-inch crank shaft lathe. The variety of heavy lathes shown is especially complete. Besides the standard lathes, a number of special lathes, including pulley lathes, turret lathes and automatic screw machines are shown. Fifty pages are devoted to planing machines, and a specially large variety of heavy planers are shown. Various methods of driving by magnetic clutches and motor mounted on the top of housings are illustrated. The large portable rotary planers are among the most interesting machines described in this section of the catalogue. These machines are self-contained, the motor being mounted on the saddle. The largest has a swing of 120 inches, and is arranged so that it can be lifted by a crane and placed in any position on a floor plate. Slotting machines and milling machines take a large number of pages—several very handsome full-page illustrations being devoted to work on the Pratt & Whitney thread milling machine. A large number of heavy drills are shown, including vertical drills, radial drills and multiple drills. Among the most interesting pages in the catalogue are those devoted to boring machines. First are the horizontal boring machines, which include all varieties of boring machines in which the work remains stationary, the cutting being done by revolving cutters. A particularly complete line of floor boring machines or horizontal boring, drilling and milling machines is shown, including every conceivable variety of these machines. Fifty pages are devoted to boring and turning mills. Here again the large mills are most interesting, but more space has been devoted to describing the smaller machines. The 16-foot and 20-foot mills are particularly massive. Following the section on boring and turning mills are a few pages devoted to miscellaneous machine tools, and then comes a very complete line of boiler shop machinery including plate planers, bending rolls, punching and shearing machines, hydraulic presses, steam and hydraulic riveters. In the latter part of the catalogue the full line of Bement steam hammers is illustrated, together with a number of installations of Niles electric traveling cranes. The last pages are devoted to the small tools made by Pratt & Whitney Co. In the arrangement of the catalogue, particular care has been taken to put the various machines in their logical order, so that any machine can be found without reference either to the table of contents in the front of the book or the complete index at the back. Metric as well as English dimensions are given throughout, and code-words are placed under each machine. The whole catalogue is a particularly good piece of press work, the cuts coming out with great sharpness and clearness. Some idea of the size of the book can be obtained from the fact that it weighs about 10 pounds, the entire edition amounting to 75 tons of catalogues. While the catalogue is not intended for general distribution it will be gladly sent to users of heavy machine tools.

## MANUFACTURERS' NOTES.

The Patterson Tool & Supply Co., Dayton, O., inform us that they have recently sold the sixth of their 13½-inch "Miami Valley" lathes to a customer in Dayton.

The Jacobs Mfg. Co., Hartford, Conn., are putting on the market a new size of the "Jacobs" improved drill chuck. This chuck was illustrated in Machinery some time back.

Beaudry & Co., Boston, Mass., builders of the Beaudry "Champion" power hammer, announce the removal of their offices from 147 Milk St. to the new Oliver Building, 141 Milk St., corner of Oliver.

The Jones & Lamson Machine Co., announce that the head office of the British branch of their company is now located at Jubilee Bldgs., 97 Queen Victoria St., London, E. C. Their telegraphic address is "Turretorum," London.

The Garvin Machine Co., New York, have sent us a neat folder containing the information that their 200-page pocket-size catalogue has just come from the printer, and that they will be pleased to mail same to parties interested.

The Ingersoll-Sergeant Co., New York, inform us that Wm. L. Saunders, who has been vice-president of the company since 1897, has been elected president to succeed Hon. Wm. R. Grace, recently deceased, who was president of the company for fifteen years.

The Crocker-Wheeler Co., Ampere, N. J., manufacturers of electric power apparatus, announce that they are to double their capital stock. The capitalization in 1899 was $1,000,000, and it has been decided to increase this amount to $2,000,000.

The American Blower Co., Detroit, Mich., recently shipped for the account of the Under-Feed Stoker Co. of America, Chicago, Ill., a consignment of seventy-eight Jones stokers to the Union Electric Light & Power Co., St. Louis, Mo.

The American Blower Co., Detroit Mich, recently installed their "A B C" system of heating in the new shops of the Olds Gasolene Engine Works, at Lansing, Mich. The apparatus consists of four units, to each of which is attached an "A B C" full-housed steel plate fan, each fan operated by an independent motor.

The F. Bissell Co., Toledo, O., inform us that they are experiencing an unusually large demand for the "Electro-Grip" device, for holding an electric lamp firmly and close to a tool or machine, when a close light is required. This device is shown in our advertising columns.

The Derry-Collard Co., 256 Broadway, New York. Folder telling of a new plan to secure technical books, known as the "D. C. Book Club." By this plan one can obtain at once a number of books while paying for them gradually. Any books, on any subjects, and by any publishers may be selected. All particulars are contained in the folder.

The Northern Metallic Packing Co., St. Paul, Minn., have appointed Geo. W. Cox & Co., Pittsburg, Pa., as their representatives in Pittsburg and vicinity for the "Northern" packing and the "Curran" railroad chime whistle. They also state that they have been granted a patent on their "Northern" metallic packing.

The Crocker-Wheeler Co., Ampere, N. J., manufacturers of electric generators and motors, will open on May 10 a branch office in New Orleans, La., in the Hibernia Bank Bldg. W. P. Field will be in charge. This new office has been made necessary to accommodate the steadily increasing market for electric machinery in the South and Southwest.

The Derry-Collard Co., 256 Broadway, New York, call attention to their series of "Monographs on Popular Technical Subjects." These treat of every-day shop operations and are intended to cover a large variety of subjects, such for instance, as: Turning tapers, drafting of cams; commutators; threads and thread cutting—recently issued. Others in course of preparation are: Wiring a house; injectors; forming lathes, reading drawings, brass-working tools; brazing and soldering, etc.

The Power & Mining Machinery Co., 52-54 William Street, New York, manufacturers of the Loomis-Pettibone gas apparatus, "Holthoff" mining machinery, and American "Crossley" gas engines, report the following installations of their products: Large contract with the Elmira Water, Light & Railroad Co., Elmira, N. Y.; and orders from the Milford Electric Light Co., Milford, N. H.; the Motor Engine Co., William Street, New York; the Amparo Mining Co., Philadelphia, Pa.; the International Steam Pump Co., New York; the Nogales Copper Co., Chicago, Ill., and the Sayles Bleacheries, at Saylesville, L. I.

The Manufacturers' Advertising Club is the name of a club recently organized in Cleveland, O., by advertising managers, for mutual benefit. Meetings will be held monthly and at each meeting an address will be delivered by an advertising expert. The officers are: Chas. B. Shanks, of the Winton Motor Carriage Co., president; Wm. Townsley, Jr., vice-president; Mrs. F. A. McIntosh, of the Standard Tool Co., secretary; and Miss E. L. Harmon, of the Loew Supply & Mfg. Co., treasurer.

The Reeves Pulley Co., Columbus, Ind., report that the Philadelphia office of the B. F. Sturtevant Co. recently placed an order with them for fifty "Reeves" variable-speed transmissions. The Sturtevant Co. are using the "Reeves" transmission on their rotary cement kilns and coal conveyors. We are also informed that the Diamond Match Co. ordered a Reeves transmission last fall, with a view of testing same. After a thorough test of this machine, of over six months, they recently ordered six more, and state that eventually they expect to equip their plant with them throughout.

The Burt Mfg. Co., Akron, O., makers of the Cross oil filter and the "Burt" exhaust head, announce that W. F. Warden, their president and general manager, sailed for Europe April 15th, to look after the interests of the company abroad. He will confine his trip to visiting agents of his company in England, France, Belgium, Germany, Norway, Sweden, Denmark, and Russia; possibly also Switzerland, Greece and Spain. J. Asa Palmer, secretary, will have full direction of the company's affairs during Mr. Warden's absence. Among the many large foreign orders recently received was one from South Africa for 30 gross of oil filters; and an order for oil filters from the Russian Government, at St. Petersburg.

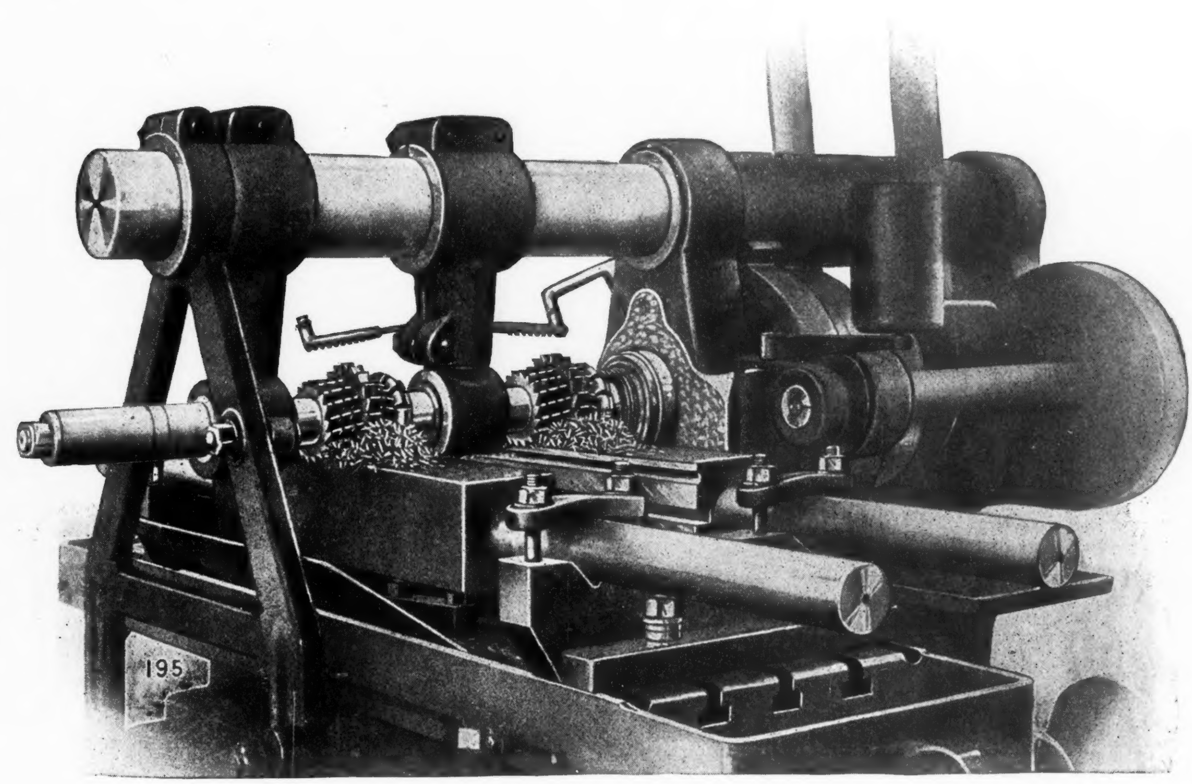
The Wilmarth & Morman Co., Grand Rapids, Mich., report, among recent shipments of their "New Yankee" drill grinders the following: Stokes & Smith, Philadelphia, Pa.; A. M. & S. Co., Baltimore, Md.; Renim Specialty Co., Boston, Mass.; J. E. Hurley, Washington, D. C.; B. & O'C. Co., Chicago, Ill.; Vulcan Iron Works, Cairo, Ill.; Emerson Steam Pump Co., Alexandria, Va.; Cushing Bros. & Co., Ltd., Calgary, Alberda; Albrecht & Height, Louisville, Ky.; Canadian Bridge Co., Walkerville, Ont.; Parkersburg Machine Co., Parkersburg, W. Va.; Eagle Square Mfg. Co., So. Shaftsbury, Vt.; Singer Mfg. Co., Cairo, Ill., Electro Dental Mfg. Co., Philadelphia, Pa.; Stewart & Bruckner, Nashville, Tenn.; Butte & Boston Consolidated Mining Co., Butte, Mont.; So. Pacific R. R. Co., El Paso, Tex.; F. Co., Montreal, Canada; King Iron Works, Buffalo, N. Y.; The Grote Mfg. Co., Evansville, Ind.; M. & H. M. Co., Chicago, Ill.; Henry Vogt Machine Co., Louisville, Ky. Also an order for nine of these grinders for England and Scotland, and an order for seven (four motor-driven) to South America.

### PNEUMATIC TOOL LITIGATION.

The Cleveland Pneumatic Tool Co., Cleveland, O., inform us that they have entered suit against the Chicago Pneumatic Tool Co., for infringement of their "Long Stroke" riveting hammers. The bill of complaint was filed in the Circuit Court of the U. S., Third Circuit, Eastern District of Pennsylvania, No. 14, April Sessions, 1904, under patent No. 665,033, issued Jan. 1, 1901. They add that manufacturers, dealers and users are equally liable under the laws governing infringement.

# 50 Point Carbon $4\frac{1}{2}$-inch Square Steel Bars.

These are finished to 4″ square, the cut is ¼″ deep, and each has one groove 21-32″ wide by ⅞″ deep, and another ¾″ wide x ¼″ deep. The illustration shows how the J. A. Fay & Egan Company, Cincinnati, finish two of these at a single cut on a




# No. 4 Plain Cincinnati Geared-Feed Miller

at a table travel of 15-16″ per minute. The cutters are 4″ and 5¾″ diameter, Novo steel, working at 30′ surface speed. The job goes through smoothly without the slightest chatter.

Everybody will admit that that's pretty fast milling for a No. 4 Machine, and that none but a "Cincinnati" can do it, but the point is, HOW FAST ARE YOU DOING SIMILAR WORK?

**LOOK UP YOUR TIME CARDS, AND THEN LET US ESTIMATE ON YOUR MILLING**

*WE ARE MILLING SPECIALISTS*

# The Cincinnati Milling Machine Company

Cincinnati, Ohio, U. S. A.

EUROPEAN AGENTS—Schuchardt & Schutte, Berlin, Cologne, Vienna, St. Petersburg, Brussels, Stockholm, Liege, Milan, Paris, Bilbao. Chas. Churchill & Co., London, Birmingham, Manchester, Newcastle-on-Tyne and Glasgow. Niles-Bement-Pond Co., 23 and 25 Victoria St., London, S. W. CANADIAN AGENTS—Williams & Wilson, Montreal. H. W. Petrie, Toronto.

## MISCELLANEOUS.

*Advertisements in this column, 25 cents a line, ten words to a line. The money should be sent with the order.*

25 COPIES "Dies and Diemaking," 50 cents each. Slightly damaged. J. L. LUCAS, Bridgeport, Conn.

AGENTS.—We want a good man in every shop to sell our mechanical books. Our men make money during spare time—so can you. THE DERRY-COLLARD CO., 256 Broadway, New York.

A STOCK of A 1 Gasoline Engine Castings, partly finished, stationary and marine, two-cycle, upright. Cylinders—3½ x 3½; 4 x 4; 4½ x 4½. A bargain. SUPERIOR GAS ENGINE WORKS, Superior, Wis.

A GOOD POSITION is always open for a competent man. His difficulty is to find it. We have openings for high-grade men in all capacities—executive, technical and clerical—paying from $1,000 to $10,000 a year. Write for plan and booklet. HAPGOODS (Inc.), Suite 511, 309 Broadway, New York.

DRAFTSMEN AND MACHINISTS.—I can obtain good patents every time, if you follow my advice; 20 years' practice; registered; low charges; highest references. EDWIN GUTHRIE, Corcoran Building, Washington, D. C.

EXPERIENCED TOOLMAKER desires position in Eastern shop. Understands small tools, jigs and fixtures. Competent to take charge. Address TOOLMAKER, care MACHINERY, 66 West Broadway, New York.

FOR CAPITALISTS.—We intend to sell the American patent for the manufacturing of our concentrical, automatically hammered, cast-iron piston rings. The value of our production has been practically proven to such a degree that all leading steam engine and motor manufacturers on the Continent and in England use our process exclusively and regularly. The manufacturing of this article produces very large profits which can be proven.
Only direct purchasers will please address, Act-Ges Davy Robertson's Maschinenfabrik, Filiale Hamburg, Hamburg, Germany.

FOR SALE.—Four bicycles, two ladies', one new, one used a year; one man's used a year, but in good condition; one boy's used a year. No reasonable offer refused. Address WHEEL, care MACHINERY, 66-70 West Broadway, New York.

MACHINISTS.—50-page book—Pointers and Rules, 25 cents; full as a nut; try it. Wm. Powles, 485 North Street, St. Paul, Minn.

PATENT FOR SALE.—Manufacturer of machinists' tools can make profitable business in buying patent, good will and stock of The Rabiger Fillet Tool. For information see adv. in January issue of MACHINERY, and for details write to RABIGER BROS. & CO. Germantown, Philadelphia, Pa.

PATTERN WORK WANTED.—Good work at reasonable prices. Prompt delivery. Let us estimate. Address Mummert, Snyder & Co., Hanover, Pa.

POSITION WANTED learning the machinists' trade by a steady young man of twenty-one years with good references. Address "Box 23, Springfield, Vt."

PATENTS.—H. W. T. Jenner, patent attorney and mechanical expert, 608 F Street, Washington, D. C. Established 1883. I make an examination free of charge and report if a patent can be had and exactly how much it will cost. Send for circular. Member of Patent Law Association.

PATENTS.—Send for "The Value in a Patent." SPEAR, MIDDLETON, DONALDSON & SPEAR, 1003 F Street, Washington, D. C.

SITUATION WANTED.—Mechanical superintendent, good executive and business manager, solicits correspondence from parties wishing up-to-date, live man; references. Address "A. B. C.," care MACHINERY, 66 W. Broadway, New York.

WANTED.—A planer 38 inches by 48 inches square by 10 feet. Address, GILLETT & EATON, Lake City, Minn.

WANTED.—Positions for reliable engineers, draftsmen, foremen and superintendents. Good men wanted to register. CLEVELAND ENGINEERING AGENCY, Station B, Cleveland, Ohio.

WANTED.—A foundry and machine company about to commence business desires to communicate with parties having patented or unpatented articles or parts to manufacture. Address "QUICK," care MACHINERY, 66 W. Broadway, New York.

WANTED.—Agents, Machinists, tool makers, increase your salary. Sell Saunders' enlarged Hand Book of Practical Mechanics. A pocket manual guaranteed to fill the bill as a ready reference and to contain more rules, shop kinks, than all the other mechanical books bound together in one volume. Secrets, from note books of best mechanics in the country, will figure out by simple arithmetic problems you run up against every day in the shop. Price, postpaid, $1.00 in cloth, $1.25 in leather with flap. Agents make big profits. Send for list of books. E. H. SAUNDERS, 216 Purchase Street, Boston, Mass.

WANTED.—A machinist in every shop to sell my Calipers and Levels. Liberal proposition. Address E. G. SMITH, Columbia, Pa.

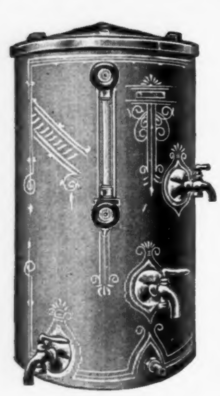
WANTED.—Automobile expert, must have mechanical and designing experience in up-to-date auto gas motor construction, and be able to produce neat and correct working drawings for shop use, and competent to take entire charge of drafting room in the department in our factory devoted to this line of work. A good position to a competent man. In answering state experience and compensation expected. Address "RED JACKET," care MACHINERY, 66 W. Broadway, New York.

WANTED.—An experienced designer of bolt and nut machinery. None but high-grade men need apply. Address "BOLTS," care MACHINERY, 66 W. Broadway, New York.

WANTED.—An expert designer of open and solid die and single and double blow cold rivet and bolt headers. State age, experience and salary wanted. Address "Box 133," care MACHINERY, 66 W. Broadway, New York.

WANTED.—A designer familiar with the construction and operation of cold rolled thread machines. None but the best need apply. Give references and state present salary received. Address "W. J. H.," care MACHINERY, 66 W. Broadway, New York.

WANTED.—To correspond with strong company that would add new line of work on royalty; shop equipped for engine manufacture preferred. MAJOR DOWNS, South Bend, Ind.



**Mr. Manufacturer:** If you are interested in the economical operation of your plant you should consider what the *Cross Oil Filter* will do. *We guarantee the Cross Oil Filter to save fifty per cent. in the cost of oil.* To prove that it will do all we claim, we send the *Cross Oil Filter* on thirty days trial. If unsatisfactory, return.

"The Cross Oil Filters are giving good satisfaction."
—W. Va. Pulp and Paper Co., Piedmont, W. Va.

**The Burt Mfg. Co.,** 227 Main St., Akron, O., U.S.A.
Largest Manufacturers of Oil Filters in the World.

**Experience** teaches that the *Burt Exhaust Head* is the only head for satisfactory service.

"The two Burt Exhaust Heads which we are using at our mines are giving good satisfaction. This is evident from the fact that we used one a year or more before we purchased the other.
—Carnegie (Pa.) Coal Co.


Send your order, with size of pipe, to-day; if dissatified, return.

**The Burt Mfg. Co.,** Largest Manufacturers of Oil Filters in the World.
227 Main Street, Akron, Ohio, U. S. A.
Also Supplied by Engine Builders, Dealers and Power Contractors.

# Tool Chests

A first-class, thoroughly well made and well finished Chest at a

**Moderate Price**

Polished oak, automatic drawer-locking device, compact and complete in every respect.

We have produced this Chest to meet the general demand for a strictly high grade Chest at a price within reach of all.
Ask for descriptive circular No. 1280.

# Pliers

Here are three "leaders" that should be of interest to Machinists and general Metal Workers.

*No. 1806½*—Imported; hand forged steel, black, best quality all 'round high grade flat nose pliers.

*No. 1806¾*—Like above but round nosed.

*Bernards Parallel*—All steel, nickel plated, open throat, well made and absolutely reliable.

**For the convenience of such of our friends as would like to order direct by mail, we name the following special prices:**

| Size | 3½″ | 4″ | 4½″ | 5″ | 5½″ | 6″ | 6½″ | 7″ | 8″ |
|---|---|---|---|---|---|---|---|---|---|
| 1806½ & 1806¾ each | $ .34 | .34 | .34 | .38 | .44 | .51 | .60 | .71 | .90 |
| Postage, each | $ .02 | .03 | 03 | .04 | .05 | .05 | .07 | .08 | .14 |
| Bernards each | | | .47 | | .60 | | .74 | | |
| Postage each | | | .05 | | .07 | | .09 | | |

No. 1806½

No. 1806¾

Bernards Parallel.

## Hammacher, Schlemmer & Co.

**Hardware and Tools**

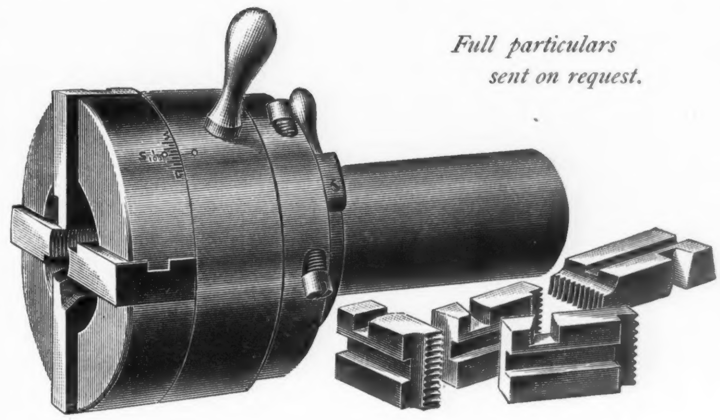
NEW HOME AFTER MAY FIRST,
FOURTH AVE. & 13TH ST.

**New York City, Since 1848**

# SCREW CUTTING DIE HEAD

**SELF-OPENING AND ADJUSTABLE**

*Full particulars sent on request.*



This illustration shows our "Style D" and is only one of several different styles which we make for almost any size or style of thread cutting.
The "Style D" is made in many sizes and is particularly well adapted to the use of Automatic Screw Machines or hand operated turrets for cutting right or left-hand threads of any diameter, pitch or form.

**They will save you time, labor, money and trouble.**
**Let us know your requirements.**

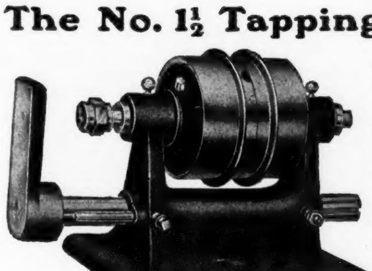
**Geometric Drill Co., Westville Station, New Haven, Conn., U.S.A.**

FOREIGN AGENTS—Chas. Churchill & Co., Ltd., London, Birmingham, Glasgow, Newcastle-on-Tyne.
Schuchardt & Schutte, Berlin, Vienna, Cologne, St. Petersburg, Brussels, Stockholm, Paris.

## Sensitive Drills and Tapping Machines

Our tools are peculiarly adapted for light, accurate work where speed is also a factor, and in design, quality of material and workmanship are standards of their class. The **No. 0 Drill,** has capacity up to $\frac{5}{16}$ inch, is convenient, easily operated, and much used in the manufacture of electrical and mathematical instruments and for light drilling in general.

## The No. 1½ Tapping Machine



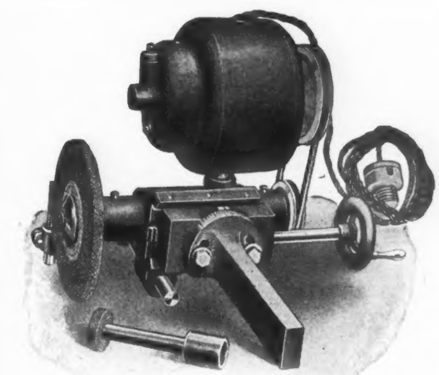
with friction drive, is being especially used by telephone manufacturers and other electrical workers, and operates very easily, and with a minimum breakage of taps.

**New catalogue shows all sizes—may we send it?**

**The Burke Machinery Co.**
**CLEVELAND, OHIO.**

# LEAKS of TIME LABOR MONEY

**STOPPED BY HEALD'S**



## Tool Post Grinders

Neat, accurate, durable, efficient and **INEXPENSIVE**

You will find no end to the work for which this tool is adapted.

**Catalogue Free**

**THE HEALD MACHINE COMPANY**
**WORCESTER, MASS.**